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1

MALARIA CONTROL IN WAR AREAS

Return to:
Dr. G. M. Jeffery

MALARIA CASES IN UNITED STATES

1942 - 43



1915

1920

1925

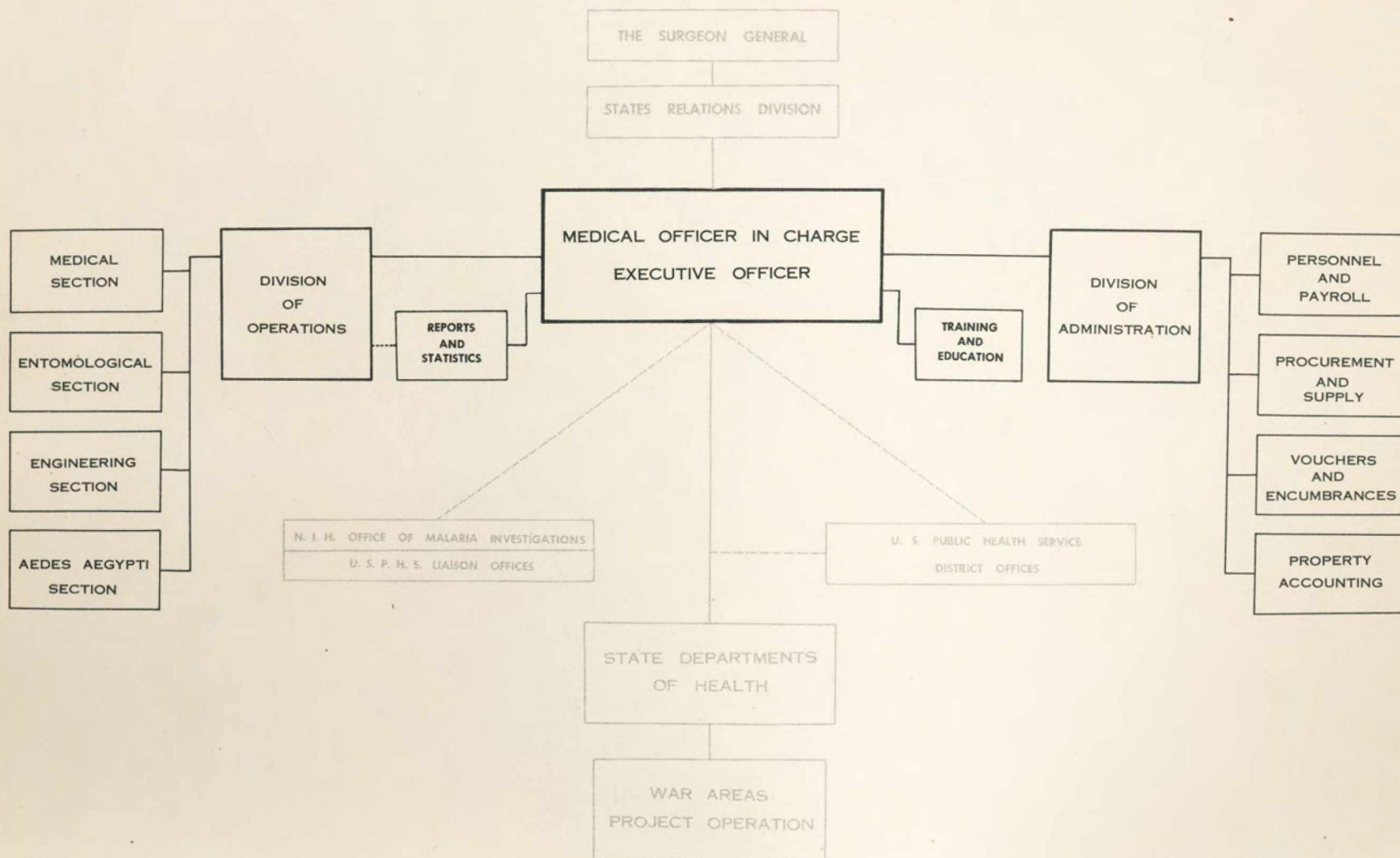
1930

1935

1940

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
ATLANTA, GEORGIA

UNITED STATES PUBLIC HEALTH SERVICE
MALARIA CONTROL IN WAR AREAS
 ORGANIZATION CHART - HEADQUARTERS OFFICE



MALARIA CONTROL IN WAR AREAS

1942 - 43

The program Malaria Control in War Areas, a joint undertaking by the Public Health Service and the several State Health Departments, is designed to control production of malaria mosquitoes and reduce potential malaria transmission in extra-cantonment zones of military and essential war industrial areas. Operation of the projects is by the State Health Departments utilizing resources of the Public Health Service. Policy direction is exercised by the Atlanta office of the Public Health Service in collaboration with the Public Health Service Districts involved.



**FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE**

ATLANTA, GEORGIA

TABLE OF CONTENTS

PART I		Page
PICTORIAL PRESENTATION OF MALARIA CONTROL IN WAR AREAS.....		1
PART II		
INTRODUCTION.....		34
OPERATIONS DIVISION.....		36
MEDICAL SERVICES.....		38
Blood Slide Surveys.....		39
ENTOMOLOGICAL SERVICES.....		41
Effectiveness of the MCWA Program.....		47
Special Entomological Survey Work.....		48
ENGINEERING SERVICES.....		51
Larvicidal Operations.....		52
Major Drainage.....		55
Insecticidal Control.....		64
MCWA IN PUERTO RICO.....		66
ADMINISTRATIVE DIVISION.....		67
PERSONNEL AND ACCOUNTS.....		69
PROCUREMENT AND SUPPLIES.....		70
SPECIAL PROJECTS AND COOPERATIVE ENTERPRISES.....		71
AEDES AEGYPTI CONTROL PROGRAM.....		71
DOG FLY CONTROL IN FLORIDA.....		78
BLOOD SLIDES FOR THE ARMY.....		79
TRAINING AND EDUCATION.....		79
COMMUNITY EDUCATION PROGRAM.....		80
PART III		
STATE SECTION.....		83

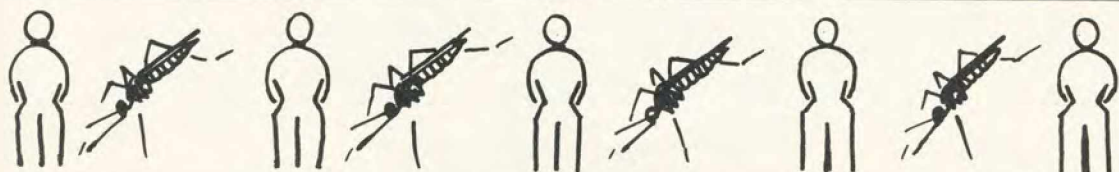
PART I

The program Malaria Control in War Areas, inaugurated in March 1942, is designed to control production of disease-bearing anopheline mosquitoes, and to reduce potential malaria transmission in extra-cantonment zones of military establishments and essential war industries.

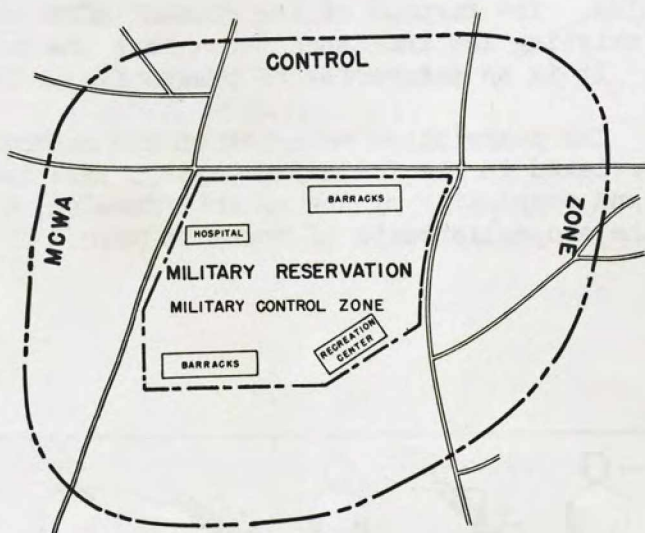
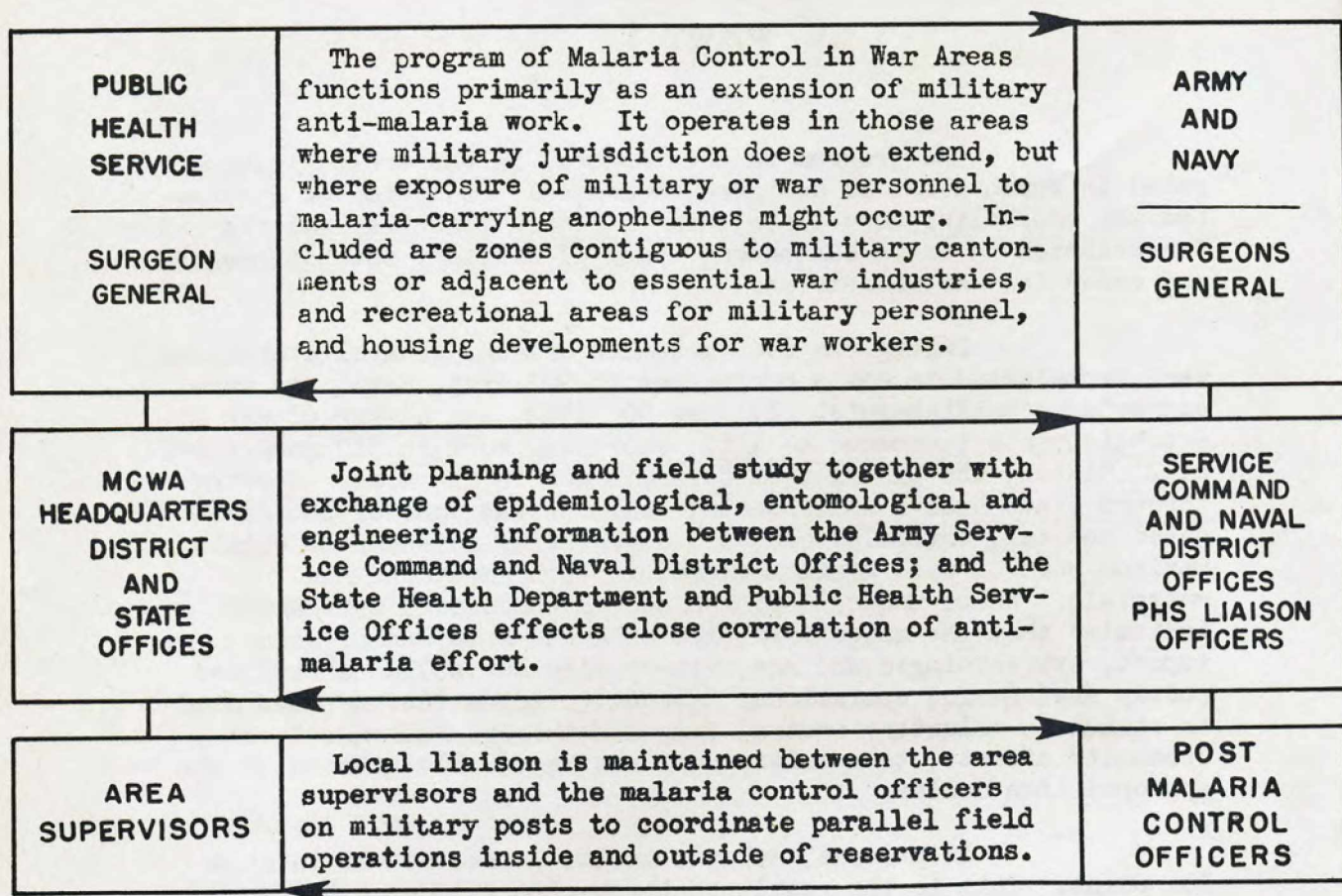
During the 1942 mosquito season, control operations were promulgated in areas contiguous to 900 Army, Navy, and war-connected establishments. By June 30, 1943, the number of war establishments increased to 1161, embracing work in 317 counties of 21 States, the District of Columbia and Puerto Rico. Working through State health departments, full use was made of coordinated medical, entomological, and engineering sciences to obtain maximum control with minimum expenditures of manpower and materials. Where medical opinion and entomological evidence indicated that the malaria problem of a war area was of minor import, epidemiologic and mosquito-density surveillance replaced costly engineering operations. Community education has been used to stimulate voluntary control programs through individual and community efforts, thus multiplying the measurable effects of the appropriation dollar.

At present, malaria in the United States is at a low point. This is the result of the cyclic nature of the disease, and control work carried on by community, state, and federal agencies. The purpose of the present MCWA program is to maintain the existing low incidence throughout the period of war mobilization. It is an enterprise of preventive medicine.

The descriptive material of the report is pictorially reviewed in the following pages. Here is depicted the enormity and complexity of the malaria problem, the method of attack, and the accomplishments of the past year.



COORDINATION WITH ARMY AND NAVY



MCWA CONTROL WITHIN A ONE MILE ZONE, (FLIGHT RANGE OF *ANOPHELES QUADRIMACULATUS*) SURROUNDING THE MILITARY RESERVATION.

MALARIA

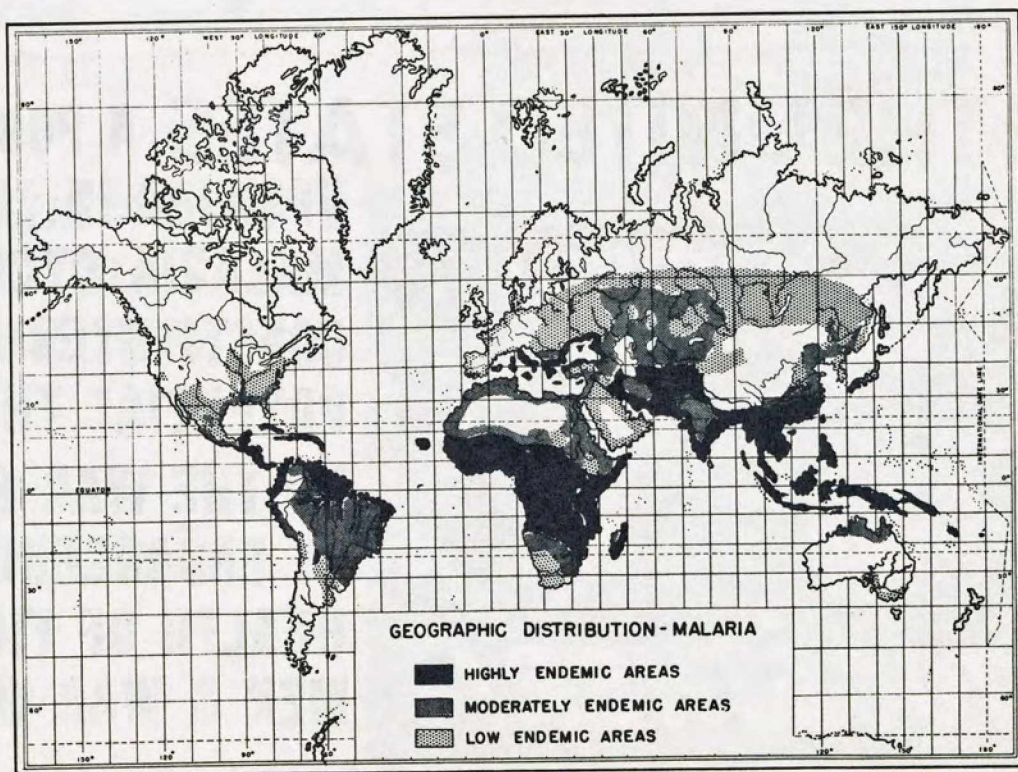
THE NUMBER ONE DISEASE OF WORLD WAR II



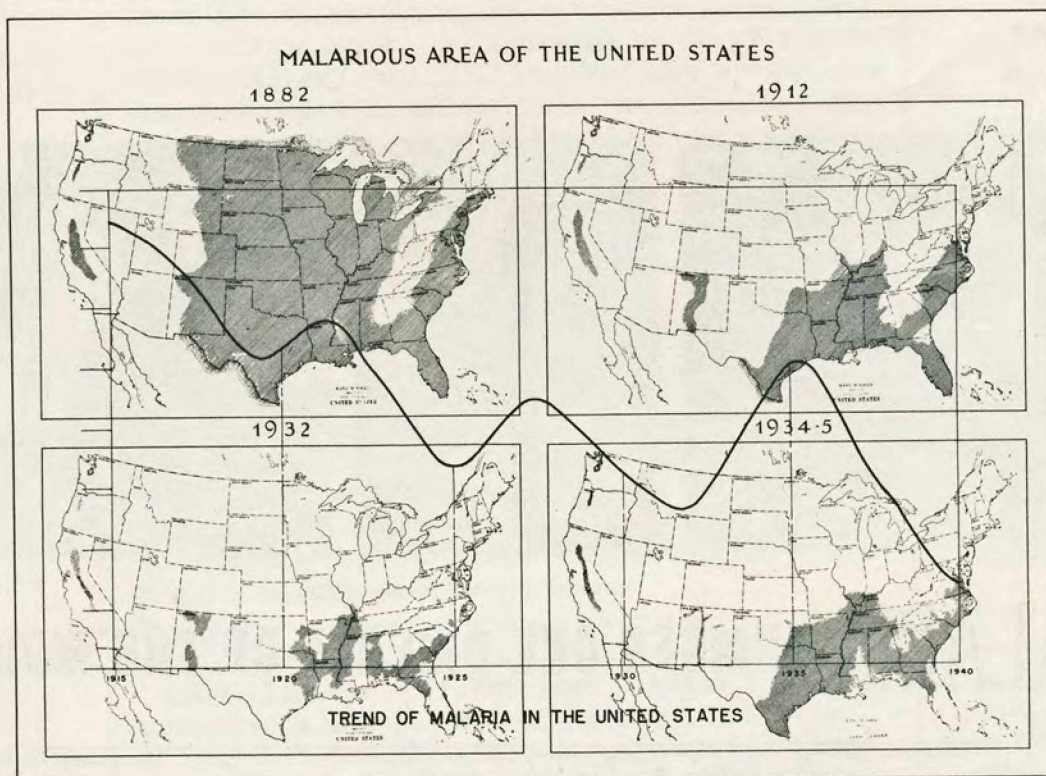
COURTESY OF LIFE MAGAZINE

MALARIA

NUMBER ONE DISEASE OF THE WORLD!



MALARIA DISEASE OF CYCLES

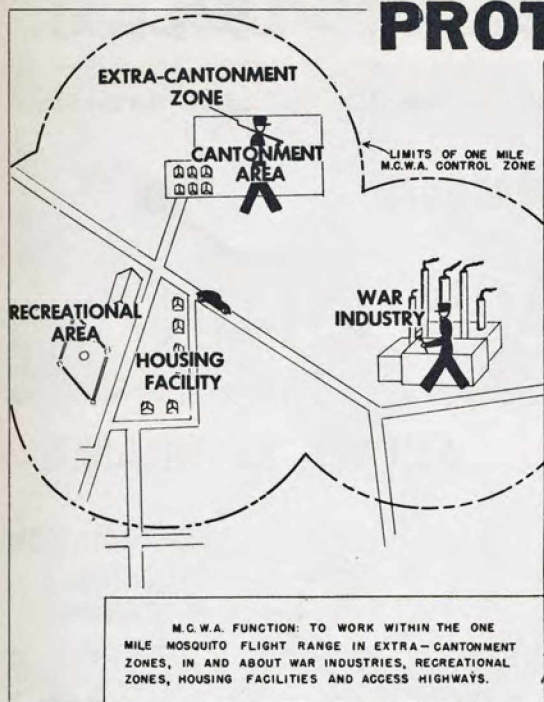


IN THE UNITED STATES A POSSIBLE UPSWING IN THE MALARIA CYCLE CONSTITUTES A POTENTIAL THREAT TO THE WAR EFFORT BY ENDANGERING THE HEALTH OF FIGHTING MEN & WAR WORKERS

MEN WORKING TOGETHER!

A black and white photograph of three men in military uniforms, looking upwards and to the right. The man on the left is wearing a helmet, the man in the middle is wearing a cap, and the man on the right is wearing a sailor's cap. They are all smiling and looking towards the right.

PROTECTION FROM MALARIA



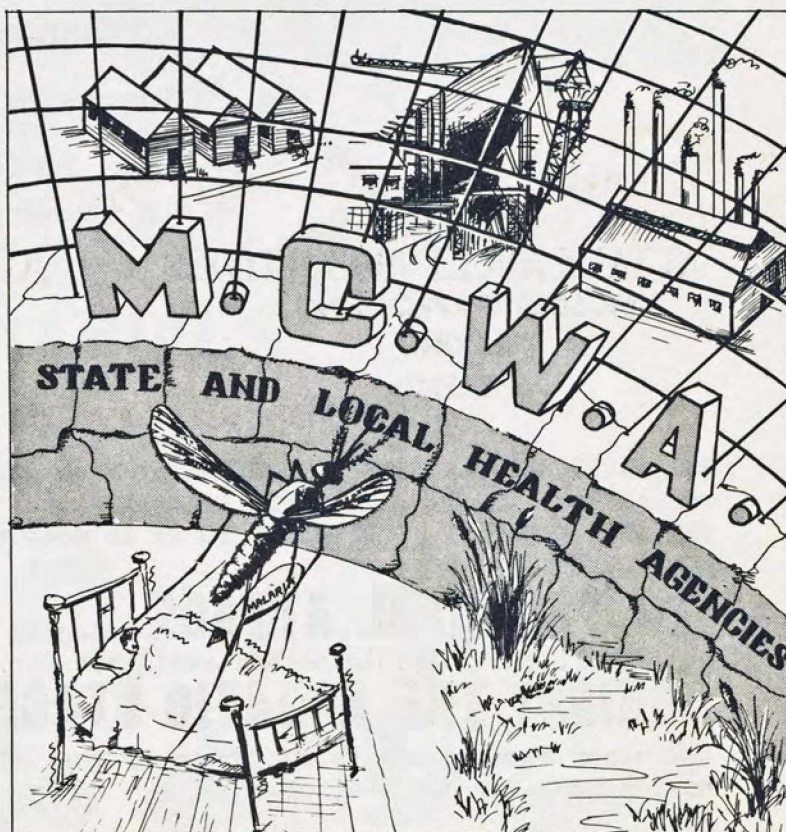
IS INSURED BY
the control work of military forces
inside reservations,
the control work of civilian health
agencies in the surrounding civil
area but
the immensity of the task has required
the support and expansion of the
normal local and state health depart-
ment facilities by the United States
Public Health Service.

2

THE RESPONSIBILITY

HAS BEEN PLACED IN THE OFFICE
OF

**MALARIA CONTROL
IN
WAR AREAS**



M.C.W.A. IS THE SUPERSTRUCTURE BUILT UPON THE SOLID FOUNDATION OF
STATE AND LOCAL HEALTH AGENCIES FOR THE PROTECTION OF FIGHTING
MEN AND WAR WORKERS.

MALARIA IS A COMPLEX PROBLEM

INVOLVING

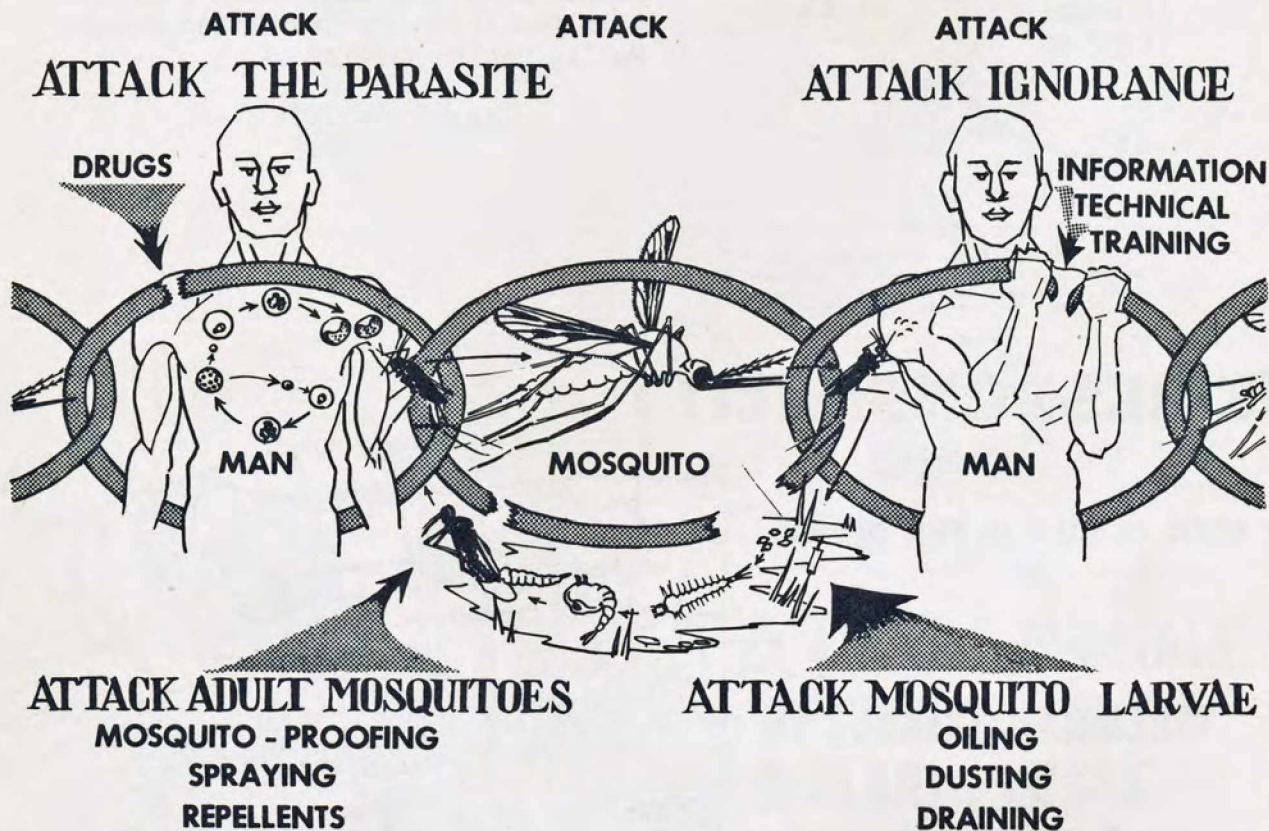
The infinite variety of relationships between the complicated life histories, habits, and behaviors of three living organisms-

MALARIA PARASITE

ANOPHELES MOSQUITO

MAN

BREAK THE MALARIA CHAIN



ATTACKING THE PARASITE WITH DRUGS by treating clinical cases and carriers reduces the danger of malaria transmission.

THE ATTACK ON THE ADULT MOSQUITO is in some cases dependable and is employed where practical, but

THE PRINCIPAL ATTACK selected because it is the most effective, practical, and reliable method available for the emergency use is **AGAINST THE AQUATIC STAGES OF MOSQUITOES**

All other attacks may be supported by the ATTACK ON IGNORANCE, which may well be the hope for eradication.

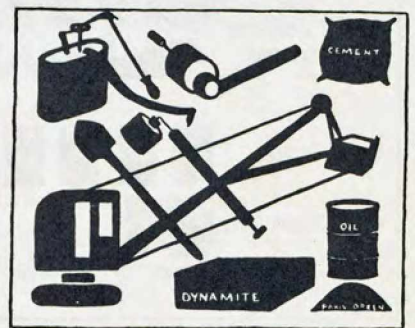
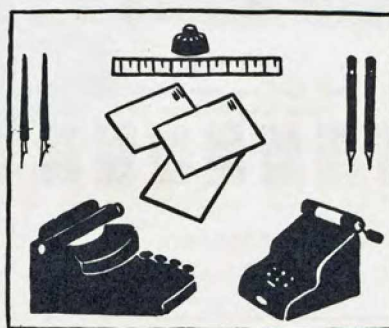
THE ATTACK REQUIRES



MEN

DOCTORS, ENTOMOLOGISTS ENGINEERS
ADMINISTRATIVE PERSONNEL & LABORERS
AND
MATERIALS

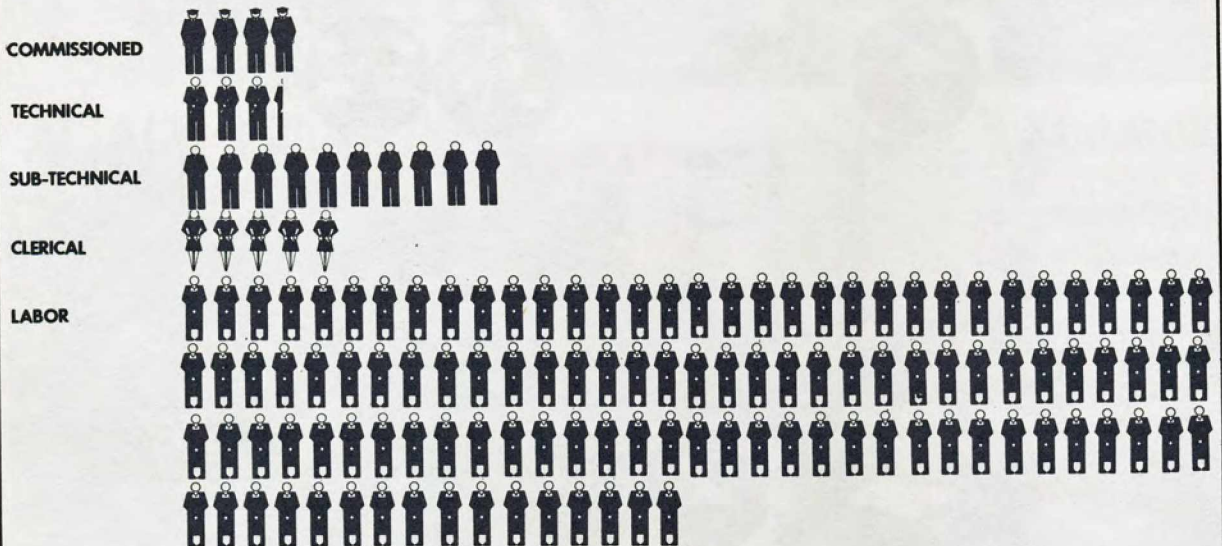
EQUIPMENT AND SUPPLIES



MEN AND MATERIALS

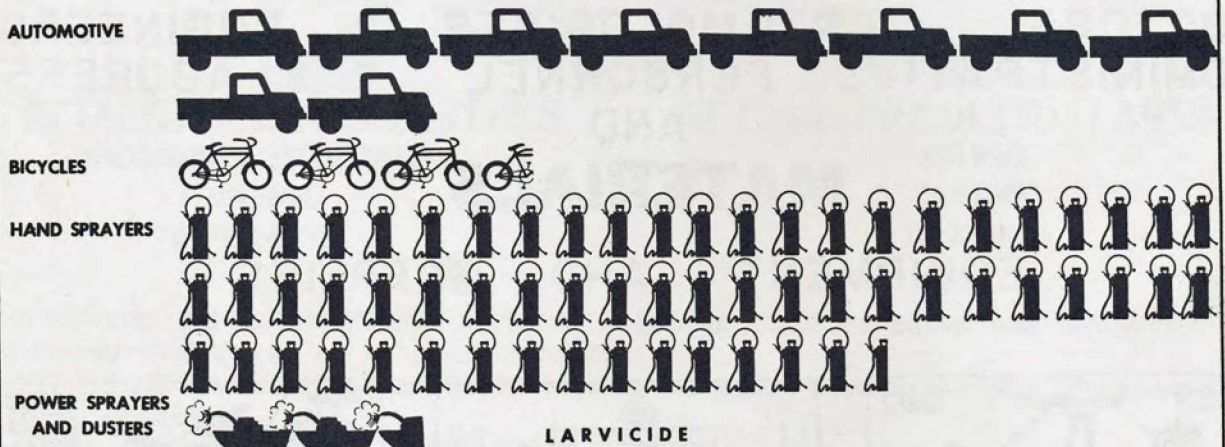
PERSONNEL

Each figure represents 25 people



EQUIPMENT

Each figure represents 50 units



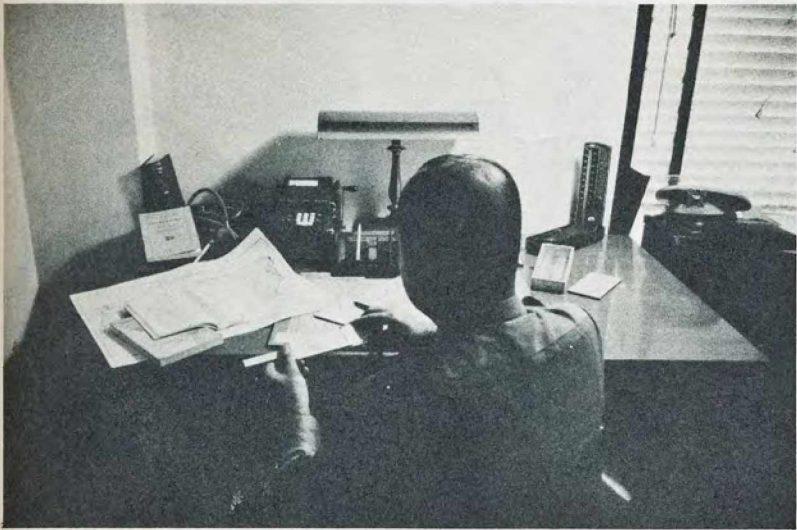
LARVICIDE

Each figure represents 100,000 units used during fiscal year 1943



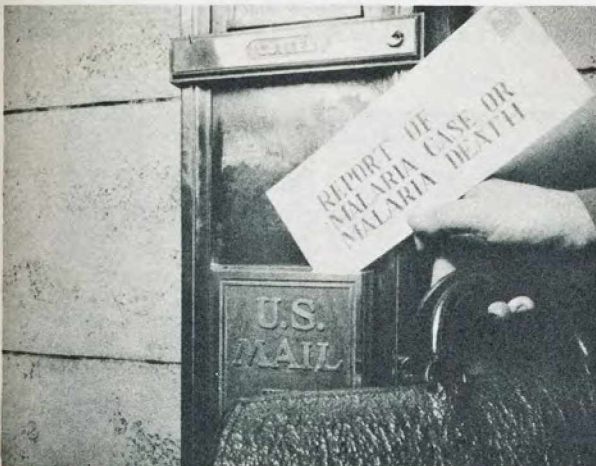
July 1, 1943

THE DOCTOR APPRAISES THE MALARIA HAZARD

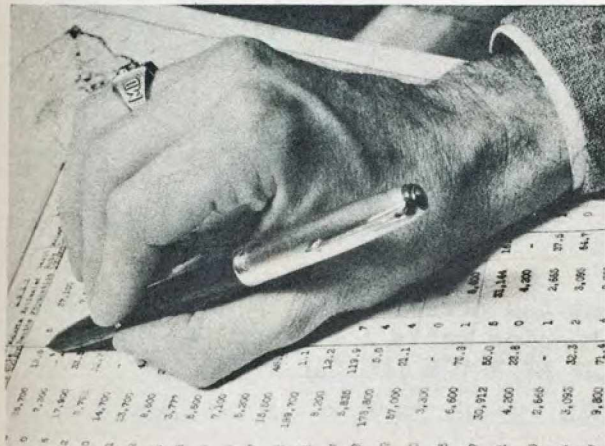


The most effective attack requires a shift of emphasis from treatment to prevention. Planning prevention requires predicting where cases may occur. Consideration is given past and present direct measurements in light of the many variable factors affecting transmission.

REPORTS OF CASES AND DEATHS form the largest source of unrefined direct measurements.

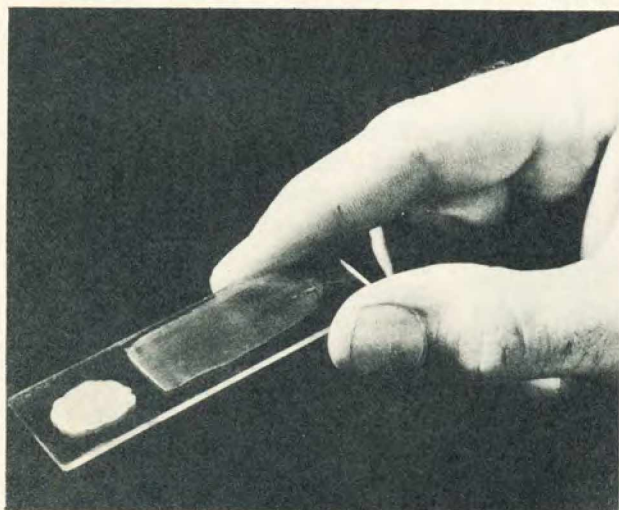


These reports reach the MCWA office from the practicing physician after they have been compiled by the state health department.



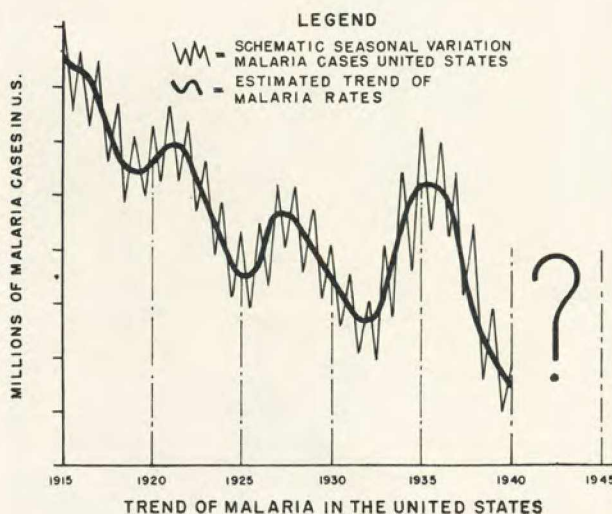
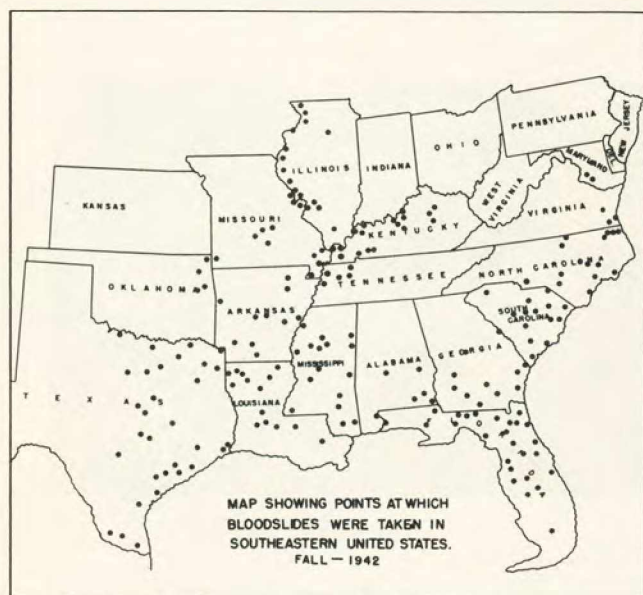
They must be kept as current as possible and carefully studied in relation to the need for control work.

567-mp
BLOOD SLIDE SURVEYS WERE MADE IN THE FALL OF 1942. 9



10
In 16 states and the District of Columbia, 120,000 blood smears were taken, of which 104,000 have been reported examined, revealing 0.21% positive. The extensive control efforts of community, state, and federal health agencies during the past decade have been largely responsible for this low incidence.

THE CYCLIC HISTORY OF MALARIA INDICATES A RISE IN INCIDENCE IF PROPER CONTROL MEASURES ARE NOT EFFECTIVELY EMPLOYED.



Because of the low incidence of malaria at the present time, EVALUATION of the effectiveness of the control program in keeping rates low cannot be done directly but REQUIRES INDIRECT MEASUREMENT BY ENTOMOLOGICAL METHODS."

MANY WAR ESTABLISHMENTS ARE IN MALARIOUS AREAS

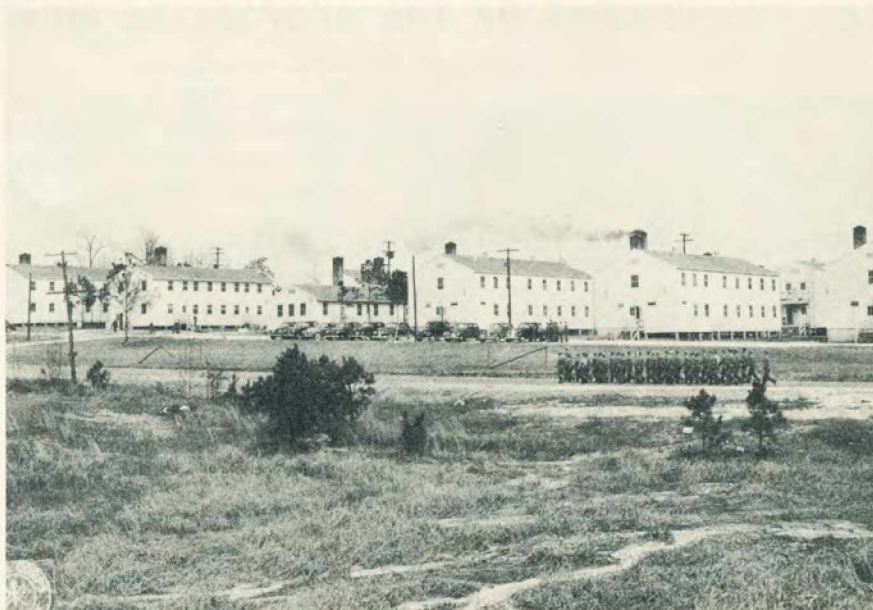
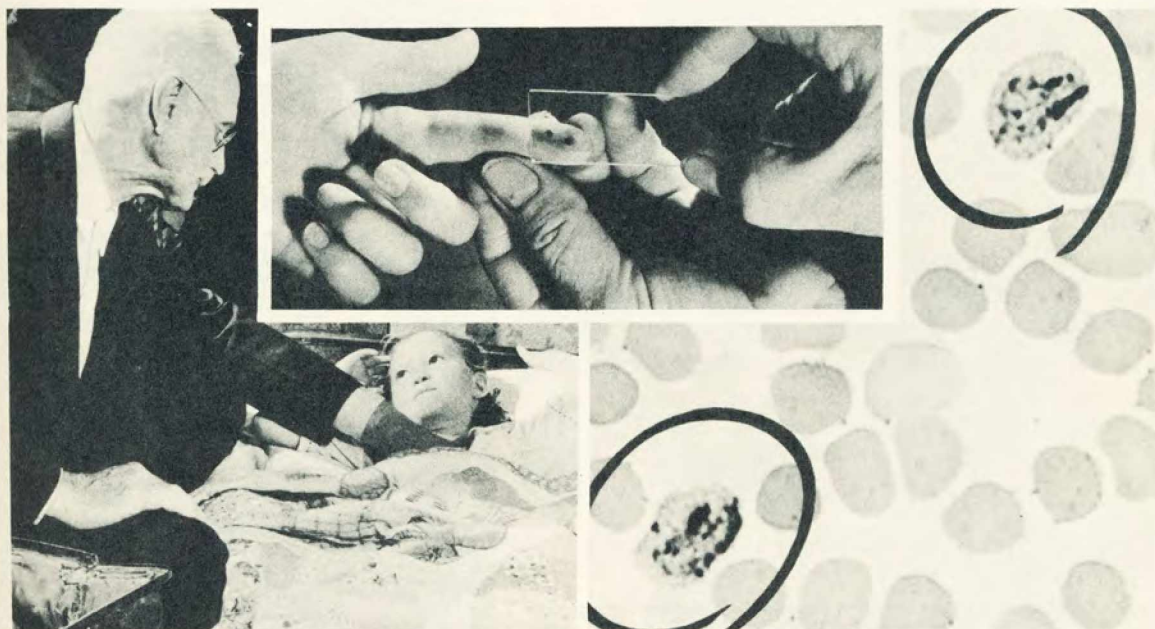


PHOTO BY U. S. ARMY SIGNAL CORPS

THE ABSOLUTE PROOF OF MALARIA IS THE OCCURENCE OF CASES.



IN POTENTIALLY MALARIOUS AREAS A PREVENTIVE PROGRAM MUST NOT AWAIT THE DISCOVERY OF CASES BEFORE BEGINNING CONTROL WORK. THE POTENTIAL DANGER DEPENDS ON THE DENSITY OF THE MALARIA VECTORS - ANOPHELINE MOSQUITOES.

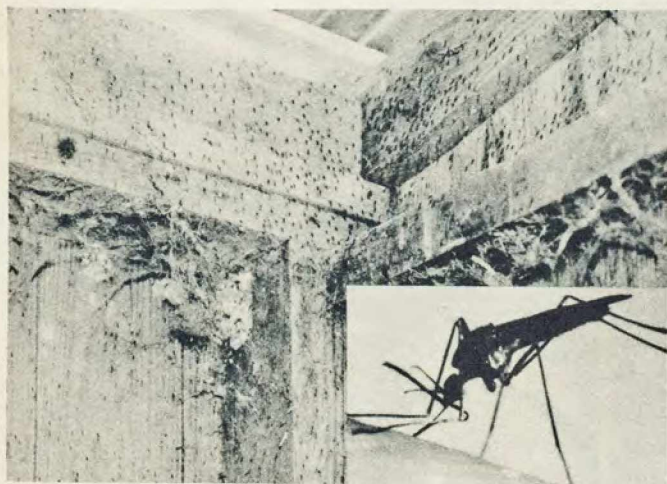
THE ENTOMOLOGIST LOCATES BREEDING PLACES AND ESTIMATES THE DENSITY OF THE ANOPHELINE MOSQUITOES

He also evaluates the effectiveness of control measures.



In studying a new project, the entomologist discusses the malaria situation with the doctor, usually a health officer.

After a conference with the doctor, the entomologist visits mosquito resting places in the vicinity of the war establishment.



ANOPHELES QUADRIMACULATUS THE VECTOR OF MALARIA *

is sometimes found in large numbers.

THE ENTOMOLOGIST OBTAINS THE BEST MAP of the locality from the County Engineer.



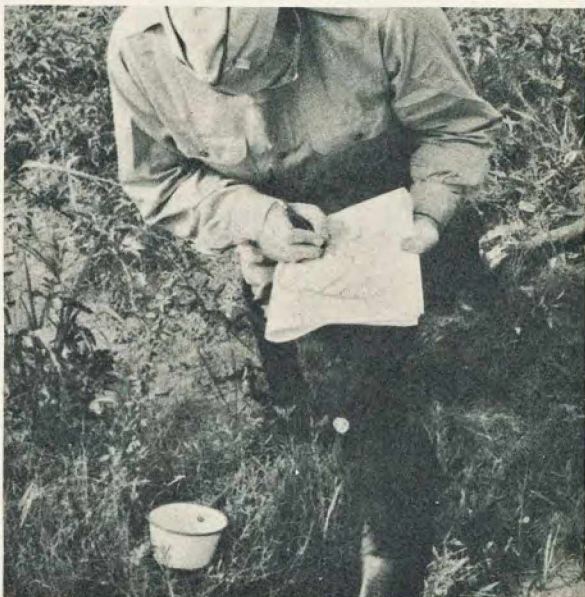
*The control program is concerned with only three species of ANOPHELES:

QUADRIMACULATUS in the eastern United States, ALBIMANUS in Texas and Puerto Rico, and FREEBORNI in the western United States.

14
THE ENTOMOLOGIST MAKES A RECONNAISSANCE SURVEY in the vicinity of the war establishment, which, for simplicity, let us call "CAMP QUAD".

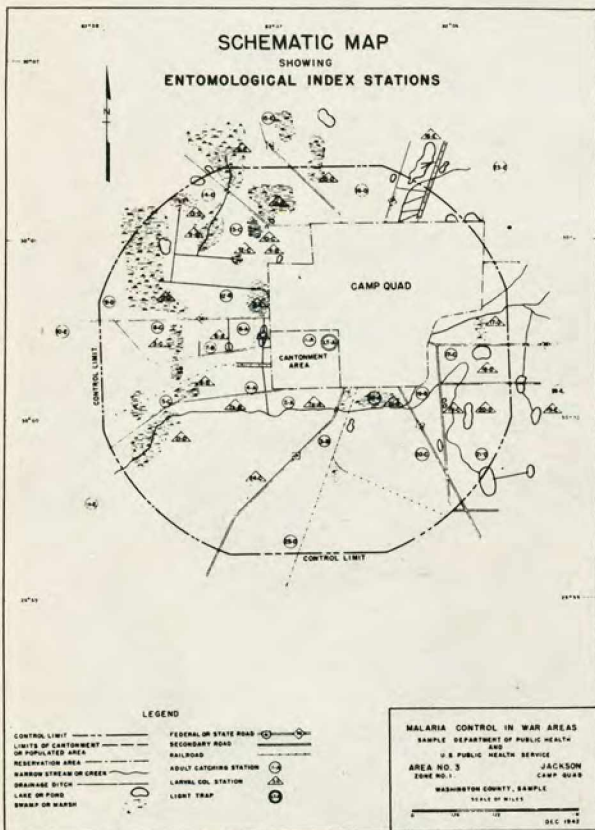


14
He DIPS FOR LARVAE and places these in a vial for identification in the laboratory. He MAPS THE LARVAL STATIONS by numbering each in a triangle symbol. He INSPECTS A NUMBER OF ADULT STATIONS near Camp Quad and maps each by a number in a circle symbol.

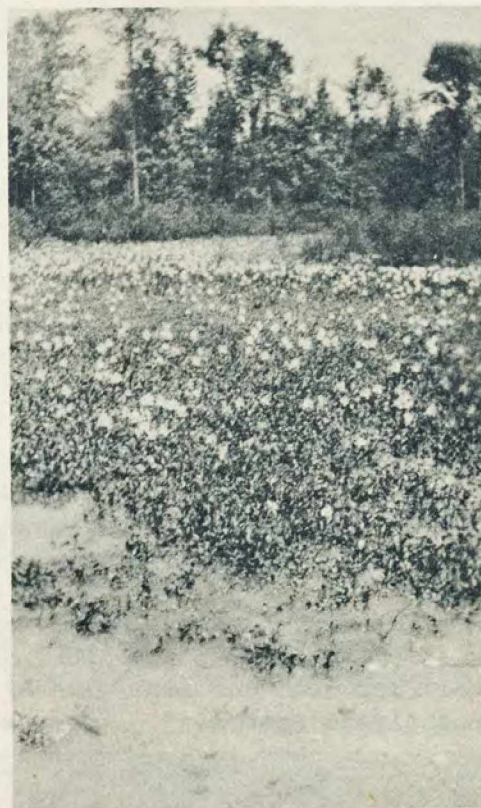


15
He IDENTIFIES THE SPECIES OF ANOPHELINE larvae with the aid of the microscope.





BREEDING PLACES ARE INSPECTED.
Larvae and adults are identified.
Notes are made and forms filled out.
THESE DATA ARE INDICATED ON A MAP
OF CAMP QUAD. The schematic map
shows the entomological index
stations for larvae and adults.



BREEDING AREAS NEAR CAMP QUAD



When the entomologist has gathered and analyzed the data, he discusses the problem with the engineer.



THE ENGINEER AND ENTOMOLOGIST MAKE A JOINT RECONNAISSANCE SURVEY around Camp Quad.



THE ENGINEER DETERMINES THE MOST EFFECTIVE CONTROL METHOD AND SETS IT INTO OPERATION

THE ENGINEER SURVEYS THE AREA.

Making the best use of available man-power and equipment, HE DECIDES ON THE MOST PRACTICABLE AND ECONOMICAL METHOD OF CONTROL. He also supervises the control work so that it functions efficiently and effectively.



WAR AREA #1 --- WORK SHEET

RELATIVE COSTS OF CONTROL BY LARVICIDING OR DRAINAGE

EXTENT OF BREEDING SURFACE ----- 210 ACRES
 LENGTH OF BREEDING SEASON ----- 24 WEEKS
 BREEDING AREA CONDITION: RELATIVELY OPEN PONDED AREAS,
 ALL PARTS REACHABLE BY BOAT
 OR MAN WEARING BOOTS.

LARVICIDING

1. IN ORDER TO TREAT ENTIRE AREA AT WEEKLY INTERVALS WITH PARIS GREEN DUST WILL REQUIRE 6 DUSTERS AND 1 FOREMAN.
 6 LABORERS FOR 24 WEEKS
 @ \$29.16 PER WEEK ----- \$4,199.04
 1 FOREMAN FOR 24 WEEKS
 @ \$39.74 PER WEEK ----- \$ 951.76
 TOTAL ----- \$5,152.80

2. - 210 LBS. PARIS GREEN @ 20 CENTS PER LB. PER WEEK FOR 24 WEEKS - - - \$1,008.00
 1,090 LBS. LIME @ \$9.00 PER TON PER WEEK FOR 24 WEEKS ----- \$ 204.12
 TOTAL ----- \$ 1,212.12

COST OF LARVICIDING \$ 6,364.92

DRAINAGE

1. TO ELIMINATE BREEDING SURFACE BY DRAINAGE WILL REQUIRE EXCAVATION OF 40,000 CU. YDS. OF EARTH IN ALL. APPROXIMATELY ONE-HALF CAN BE DUG WITH DRAG-LINE AT 35 CENTS PER CU. YD. ----- \$ 7,000.00
 OTHER HALF CAN BE HAND EXCAVATED @ \$1.00 PER CU. YD. ----- \$20,000.00
 COST OF DRAINAGE ----- \$27,000.00

ABOVE INCLUDES CLEARING OF HEAVY STUMPAGE, EXCAVATING, MOVING EQUIPMENT, ETC.

QUESTIONABLE WHETHER DRAINAGE CAN BE OBTAINED IN THIS AREA AT THIS TIME.

Conclusion:

Area to be controlled by means of larviciding

WAR AREA #2 --- WORK SHEET

RELATIVE COSTS OF CONTROL BY LARVICIDING OR DRAINAGE

EXTENT OF BREEDING SURFACE ----- 1190 ACRES
 LENGTH OF BREEDING SEASON ----- 24 WEEKS
 BREEDING AREA CONDITION: EXTENSIVE MARSH AND INTERMITTENTLY WOODED AREA. BOTTOM VERY SOFT SO AS TO BE UNSAFE FOR WADING AND GENERALLY TOO SHALLOW AND OVERGROWN FOR BOAT.

LARVICIDING

1. AIRPLANE DUSTING AT WEEKLY INTERVALS ONLY FEASIBLE METHOD.
2. AVERAGE DUSTING TIME PER HOUR 6 HOURS @ \$55 PER WEEK FOR 24 WEEKS ----- \$ 7,920.00
 AVERAGE STANDET TIME PER WEEK 10 HOURS @ \$20 PER HOUR FOR 24 WEEKS ----- \$ 4,800.00
 FERRYING MILEAGE 200 MILES PER WEEK @ \$.70 PER MILE FOR 24 WEEKS ----- \$ 3,360.00

3. MIXING, TRANSPORTING AND SERVICING:
 4 LABORERS AND 1 FOREMAN FOR 24 WEEKS ----- \$ 3,753.12

4. 1,190 LBS. PARIS GREEN @ 20 CENTS PER LB. PER WEEK FOR 24 WEEKS ----- \$ 5,712.00
 43 TONS LIME @ \$9 PER TON ----- \$ 387.00
 COST OF LARVICIDING ----- \$25,932.12

DRAINAGE

1. AREA SUITABLE FOR DYNAMITE DITCHING.

2. COMPLETE DRAINAGE WILL REQUIRE EXCAVATION OF 30,000 CU. YDS. OF EARTH.

APPROXIMATELY THREE-FOURTHS TO BE BLOWN WITH DYNAMITE @ 30 CENTS PER CU. YD. ----- \$ 6,750.00

APPROXIMATELY ONE-FOURTH HAND EXCAVATED @ \$1.00 PER CU. YARD ----- \$ 7,500.00
 COST OF DRAINAGE ----- \$14,250.00

Conclusion

Area to be drained by means of dynamite and hand ditching

Cost is an important consideration. It always influences the engineer's decision on the method of control. If larvicidal operations are chosen, OIL AND PARIS GREEN ARE THE TWO LARVICIDES COMMONLY USED. The cost of paris green is low. It is toxic primarily to Anopheline larvae, whereas oil is effective against all types of mosquito larvae.

HAND DUSTING with paris green is an effective means of treating small breeding areas, such as ditches, borrow pits, and pond margins.



POWER DUSTING from a boat is suitable for covering extensive breeding waters.

AIRPLANE DUSTING is a highly effective method where breeding areas are large and inaccessible.

13 25 17 17
 9 HAND-SPRAYING is the most common method of application of liquid larvicide.



POWER-SPRAYING from a boat is often used for control by the engineer. 31



Power equipment is stressed in an effort to help solve the problem of labor shortage. 32



34 33 10 20 20
 INSPECTION BY THE ENTOMOLOGIST IS A CHECK ON THE EFFECTIVENESS OF LARVICIDAL MEASURES. 30 20 18

22
 DRAINAGE IS OFTEN THE MOST PRACTICAL AND ECONOMICAL METHOD OF CONTROL.

Even in this emergency program 30

14
 HAND DITCHING is employed for small ditches. 30

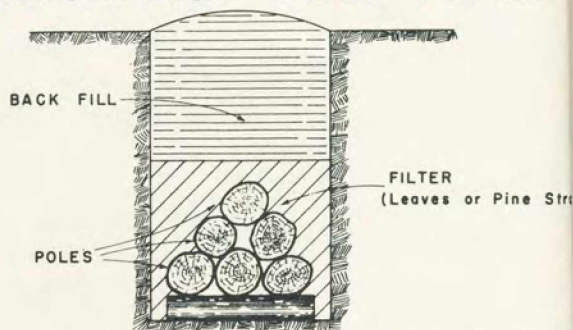


37
 FILLING may be an economical method of permanent elimination of breeding. 26 13

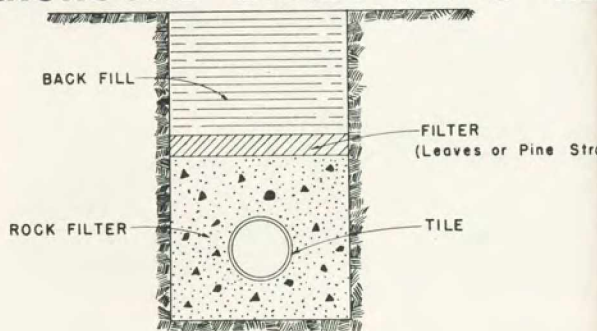


12
22
39
40
THE DRAGLINE is an economical method of digging large drainage ditches with limited manpower.

UNDERGROUND POLE DRAIN A



UNDERGROUND DRAIN USING TILE E



UNDERGROUND DRAINAGE requires a minimum of maintenance and is particularly useful for the removal of seepage water.



43
42 41
17
DYNAMITE DITCHING is an economical method of ditch construction under suitable soil conditions. Engineers frequently select this method for anti-malaria drainage projects. It requires few men and almost no equipment.

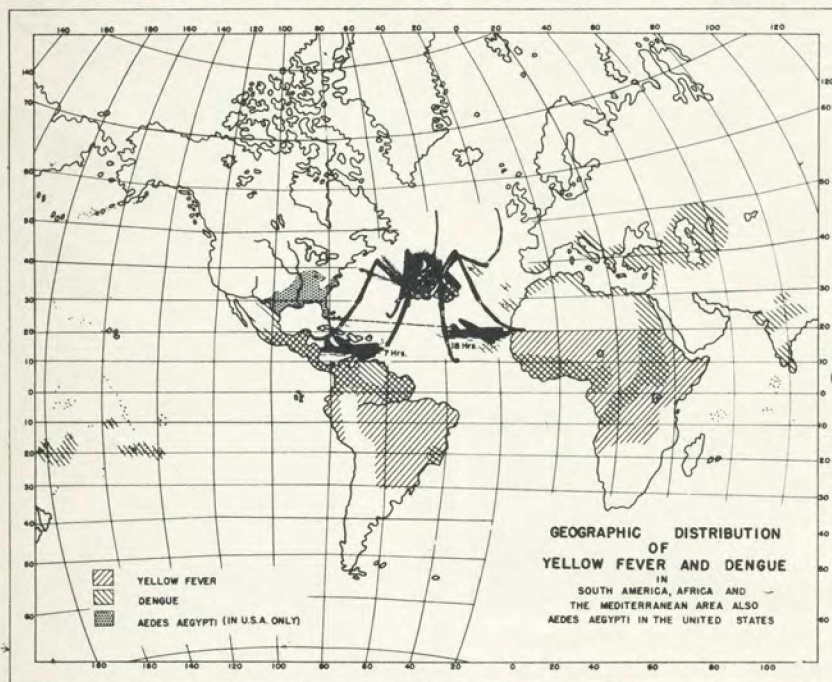
DENGUE AND IMPORTANT F seven hours tropics may

Visits were places. Co

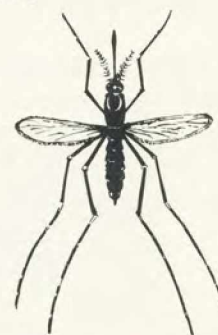


ARTIFICIAL WA house are bre range is less

DENGUE AND YELLOW FEVER PREVENTION BY CONTROL OF Aedes aegypti IS ALSO AN IMPORTANT HEALTH MEASURE. Both diseases are endemic in countries within seven hours flying time of the United States. Troops returning from the tropics may bring these diseases to ports infested with Aedes aegypti.

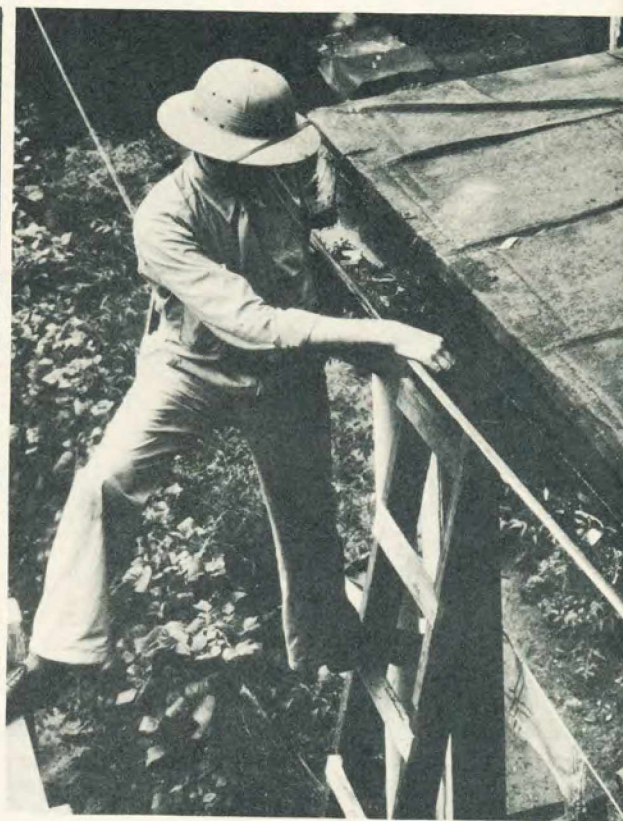


Visits were made to 1 1/2 million premises to inspect and correct breeding places. Correction was found necessary on over half of these.



ARTIFICIAL WATER CONTAINERS both inside and outside the house are breeding places for Aedes aegypti. Its flight range is less than one block.

SPECIAL CONTROL MEASURES include PLANTING LARVAE-EATING MINNOWS in pools, cisterns and wells; CORRECTION OF GUTTERS; oiling cisterns; clean-up of premises; and maritime inspection of beach and docked boats.



AEDES AEGYPTI is primarily a tropical mosquito. It lives in the temperate zones either through re-introduction each year or through survival in permanent "mother focus" breeding spots

Over 1,200 cisterns were mosquito-proofed, and 20,000 cotton warehouse fire-barrels were treated with long lasting phenothiazine larvicide.



Since the AEDES AEGYPTI is a completely domestic mosquito, INDIVIDUAL ACTION CAN BE EASILY TRANS-LATED INTO SUCCESSFUL CONTROL.

Armed with
which minim
Education c
in War Area
kept low.

n pools,
-up of

TRAINING AND EDUCATION

THE ATTACK ON IGNORANCE

44-

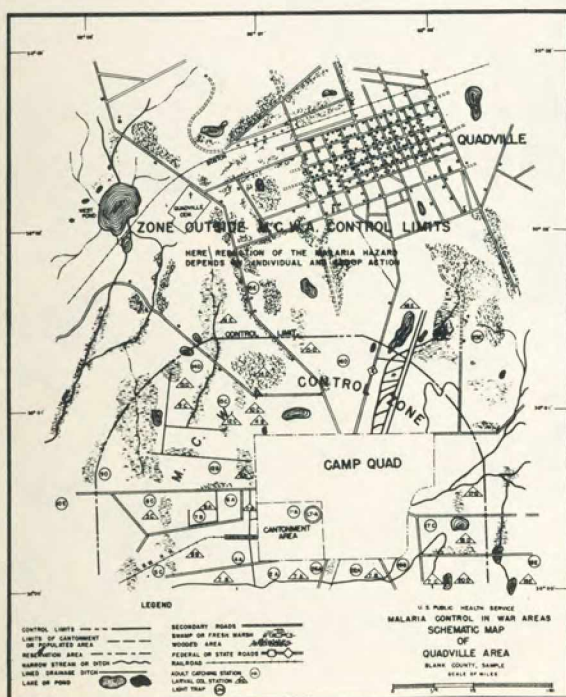


45

PEOPLE PLUS FACTS EQUAL ACTION.
THIS INSURES INCREASED PROTECTION.

Armed with facts and an understanding of the problem, people take action which minimizes and may ultimately eradicate malaria as a human disease. Education creates a secondary line of defense outside the Malaria Control in War Areas zones. By individual and group action, endemic reservoirs are kept low.

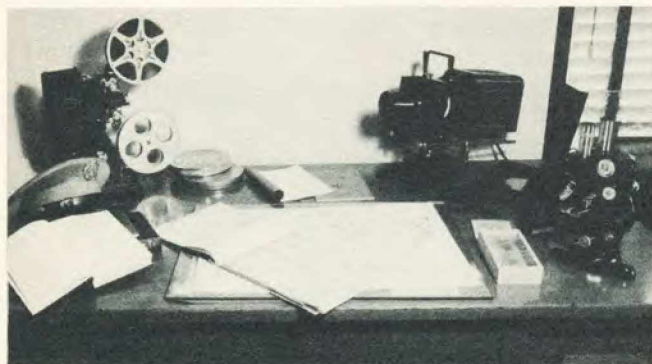
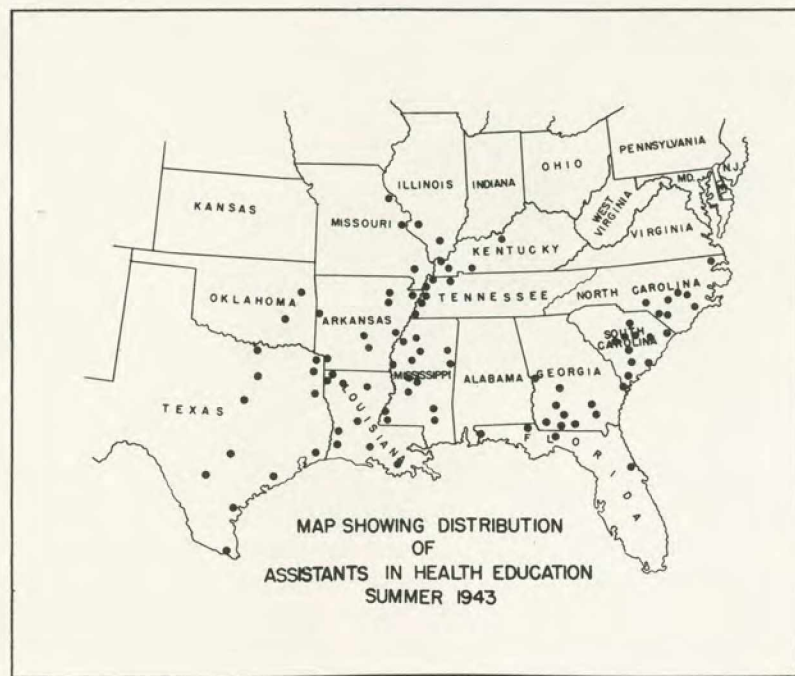
use fire-



46

47
Bed net

Last year 26 teachers, assigned to health officers throughout the Southeastern United States, conducted malaria educational work in their respective communities. The results of their efforts justified an extension of the program this year. After an intensive two weeks training period at the beginning of the summer, 92 teachers continued this work.



CLASS-ROOM AND FIELD TRAINING, both theoretical and practical, is necessary for the professional personnel. Acute shortage of trained men require the use of the most efficient techniques in order to reduce to a minimum the time required for training.



ADMINIS

THE EXECUTIVE
ESTABLISHED
ORDINATES

GENERAL AD
FROM THE F
AND IS FUN
VICE TO TH
TECHNICAL

NUM

OREGO

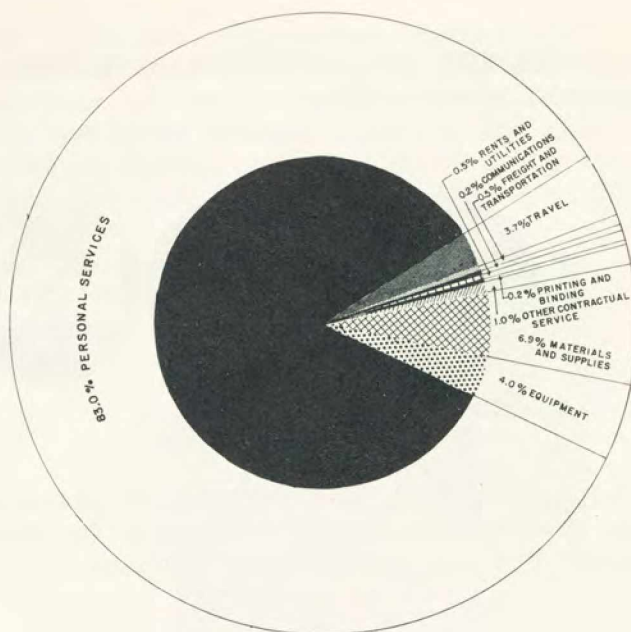
In additi:
\$1,500,00

southeastern
ve communities.
this year.
e summer, 92

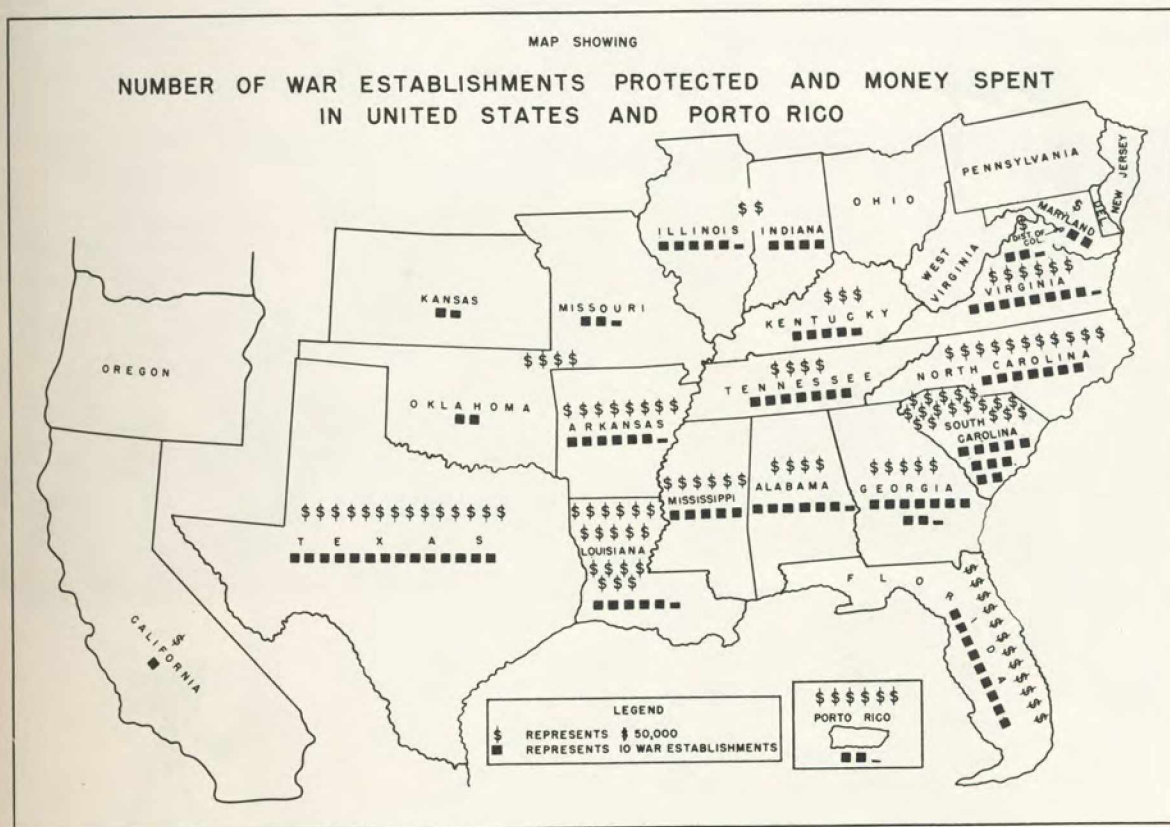
ADMINISTRATION

THE EXECUTIVE ADMINISTRATION
ESTABLISHES POLICY AND CO-
ORDINATES FUNCTIONS.

GENERAL ADMINISTRATION STEMS
FROM THE EXECUTIVE OFFICE
AND IS FUNDAMENTALLY A SER-
VICE TO THE PROFESSIONAL AND
TECHNICAL PERSONNEL.

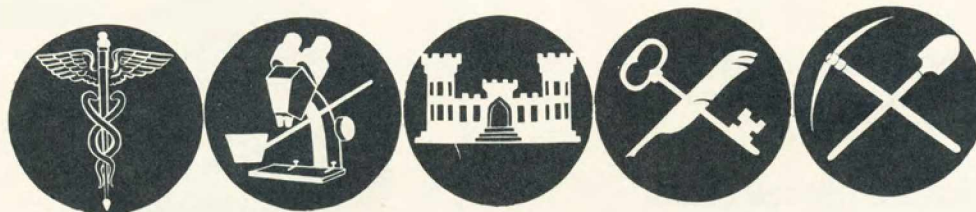


EXPENDITURES FOR THE FISCAL YEAR 1943

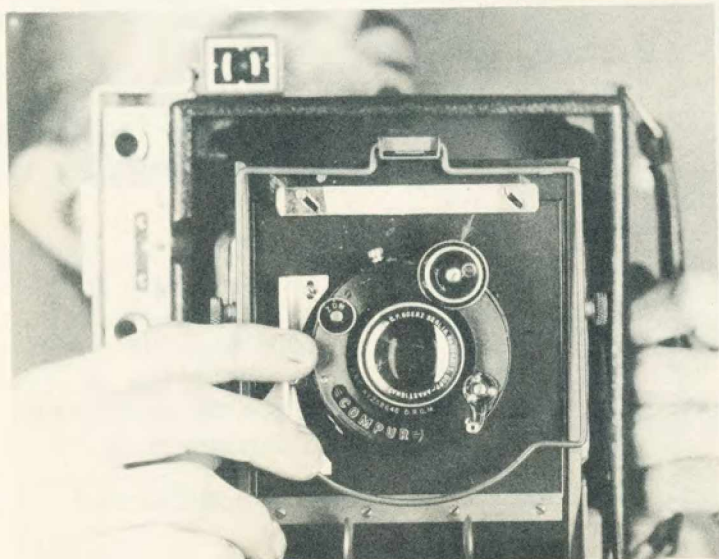


In addition to the above, state and local health departments contributed \$1,500,000 in the form of personnel, services, and supplies.

THE PROCUREMENT AND ASSIGNMENT OF PROFESSIONAL PERSONNEL is a prime requisite of continued operation.



MAPPING, DRAFTING, and PHOTOGRAPHY prepared 320 malaria control maps drawn from sketches and basic field data for reproduction, over 250 graphs and charts, and hundreds of photographs.



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FIELD EQUIPMENT AND SUPPLIES of over 300 kinds, from entomological vials to heavy power machinery, are necessary to operate the larvicide and drainage projects. To conserve critical materials and to save money, surplus items worth \$250,000 were transferred from curtailed federal agencies and supplied 60% of the 54,000 pieces of larvicidal equipment and small hand tools now in use, 62% of the 504 automotive vehicles, and 35% of the 6,900 pairs of rubber boots.



In the Atlanta warehouse smaller equipment was reconditioned. Paris green and pyrethrum insecticide were purchased at quantity prices and distributed from the warehouse. Though much federal surplus material was procured and distributed directly from the field points, the total weight of equipment and supplies handled by the warehouse during the year amounted to over 500 tons.



MONTHLY REPORTS, SPECIAL REPORTS AND INFORMATIONAL AIDS WERE PREPARED BY THE PERSONNEL OF THE PROGRAM.



A DISCUSSION: THE DETERMINATION OF DENSITIES OF POPULATIONS OF *ANOPHELES QUADRI MACULATUS* ON THE WING BY LIGHT TRAPS, BY NAIL KEYS, BY RESTING PLACES, AND BY RESTING AND FEEDING PLACES

BY
G. H. Brodley, S.
Malaria Cr.
U. S. Pub.

MALARIA CONTROL IN WAR AREAS
ENTOMOLOGICAL SERVICES IN THE REGULATION
OF THE LARVICIDE PROGRAM

BY
G. H. Brodley, Senior Entomologist RO

THE RELATION OF DENSITY OF POPULATION OF *ANOPHELES QUADRI MACULATUS* TO THE PREVALENCE OF MALARIA

BY
Dr. L. L. Williams, Jr. Medical
Malaria Cr.

THE SPLEEN SURVEY AS APPLIED TO THE MEASUREMENT OF MALARIA IN THE UNITED STATES

BY
Surgeon Samuel Spicer

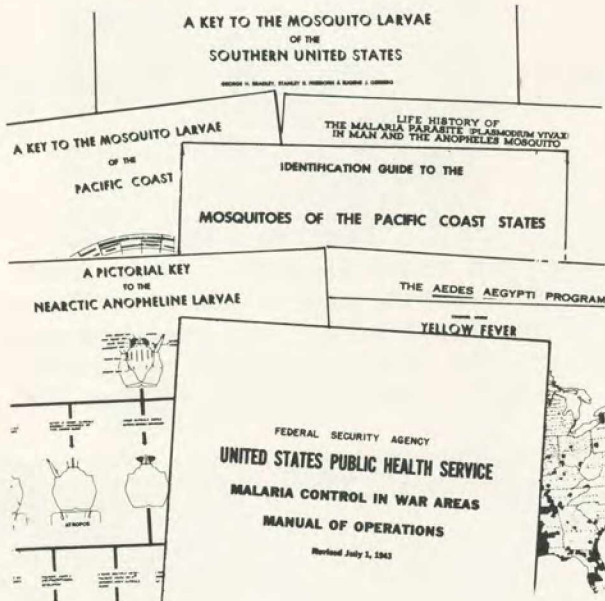
COMMUNITY EDUCATION FOR MALARIA CONTROL
A Supplementary Malaria Control in War Areas Program

BY
J. A. Moore, M.D.

COMMUNITY EDUCATION FOR MALARIA CONTROL
MALARIA CONTROL IN WAR AREAS PROGRAM

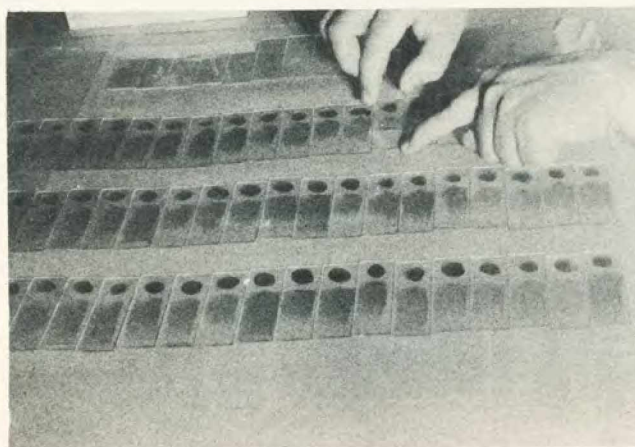
THE TREATMENT OF MALARIA
N. J. Corrozzo

THE HISTORY AND CHEMISTRY OF THE ANTI-MALARIAL COMPOUNDS

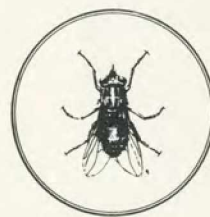


COOPERATIVE ENTERPRISES

28,000 malaria smears were prepared and sent to the Army Distributing Center for distribution to medical schools.



DOG FLY CONTROL



At Army request, the Public Health Service cooperated with the U. S. D. A., Bureau of Entomology and Plant Quarantine in dog fly control in the vicinity of military establishments in Florida.

PREPARED
PROGRAM.

PLANS, PROFESSIONAL SKILL, MEN AND MATERIALS MUST PRODUCE RESULTS IN TERMS OF REDUCED MALARIA HAZARD

6,250,548 MAN HOURS WERE EXPENDED FOR ALL OPERATIONS.

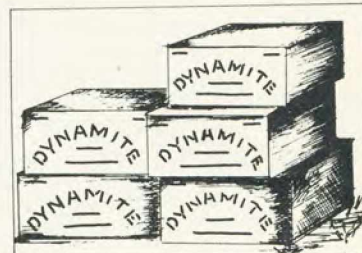


12,940 ACRES OF LAND OR WATER WERE CLEARED PRIOR TO LARVICIDING AND DRAINAGE.



4,319 MILES OF DITCHES WERE CLEANED.

448,800 POUNDS OF DYNAMITE
WERE USED FOR DITCHING.



152,267 POUNDS OF PARIS GREEN WERE DUSTED
AND



1,876,607 GALLONS OF OIL WERE SPRAYED
TO LARVICIDE APPROXIMATELY 200,000
ACRES OF WATER.

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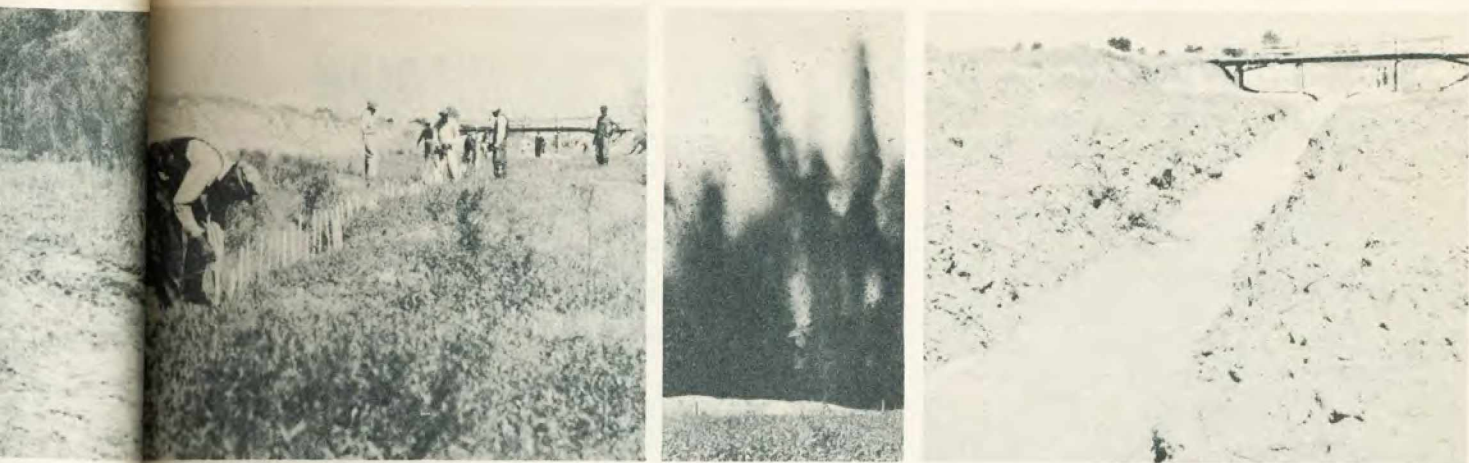
1,090 MILES OF MINOR DITCHING ELIMINATED 5,441 ACRES OF BREEDING SURFACE.



12,534 LINEAR FEET OF DITCHES LINED WITH DURABLE MATERIAL WERE CONSTRUCTED.
7,005 LINEAR FEET OF UNDERGROUND DRAINAGE WAS INSTALLED.

THE PROOF OF THE DITCHING IS IN THE DRAINING.





DYNAMITE DITCHING IS FAST, CHEAP, AND SIMPLE.



CUBIC YARDS EXCAVATED MEAN BREEDING PLACES ELIMINATED.

CONCRETE LINED DITCHES ARE MOST EFFECTIVE AND LASTING.

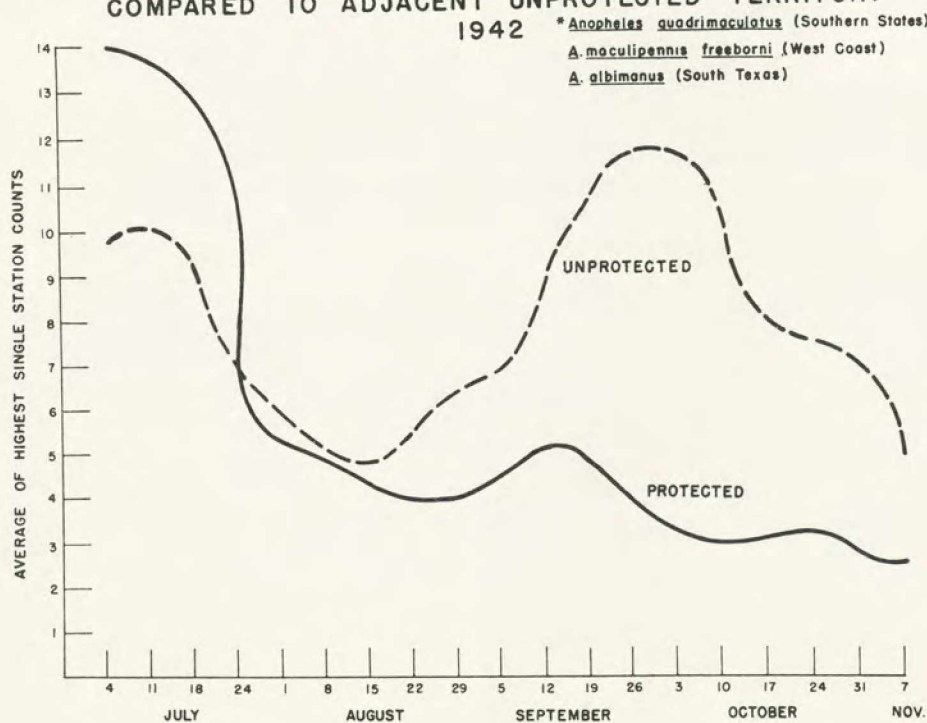


BREEDING PLACES WERE ELIMINATED BY DRAINAGE; PERIODIC LARVICIDAL APPLICATIONS WERE MADE THEREBY DESTROYING NUMBERLESS MALARIA MOSQUITOES.














POPULATIONS OF ANOPHELES QUADRIMACULATUS WERE REDUCED, THEREFORE THE THREAT OF MALARIA WAS MINIMAL. MALARIA INCIDENCE WAS THE LOWEST IN HISTORY.

DENSITIES OF MALARIA VECTORS* INSIDE PROTECTED ZONES
COMPARED TO ADJACENT UNPROTECTED TERRITORY
1942

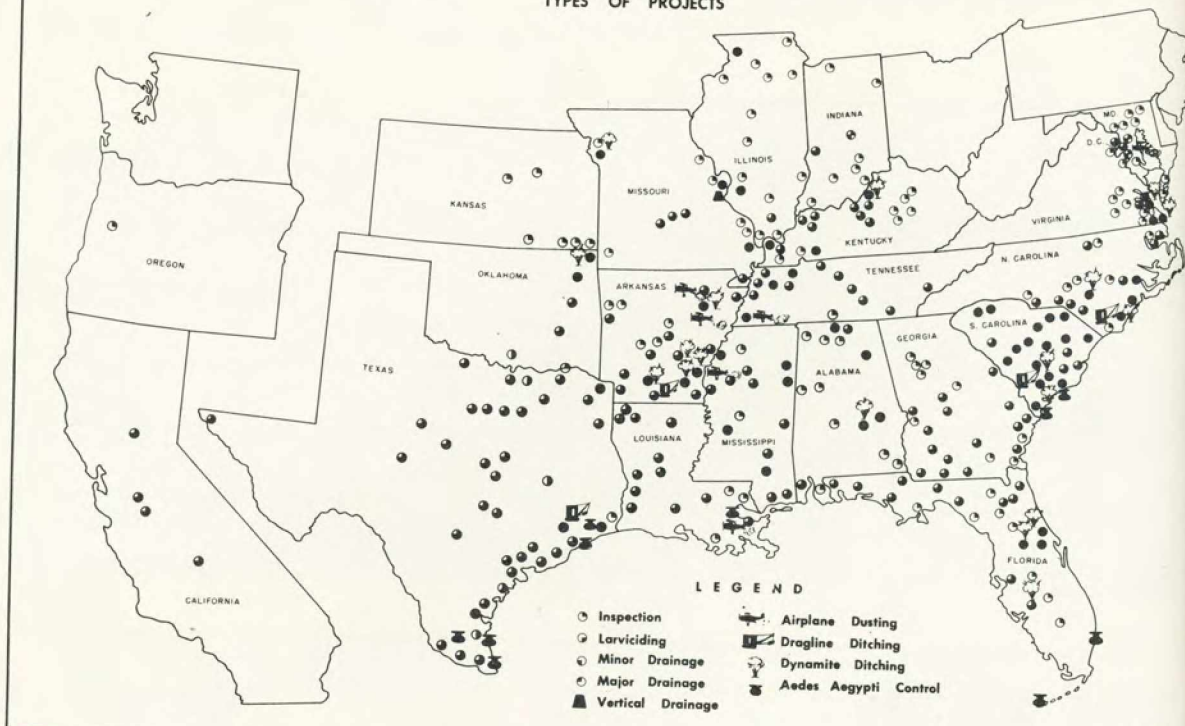


SUMMARY OF OPERATIONS

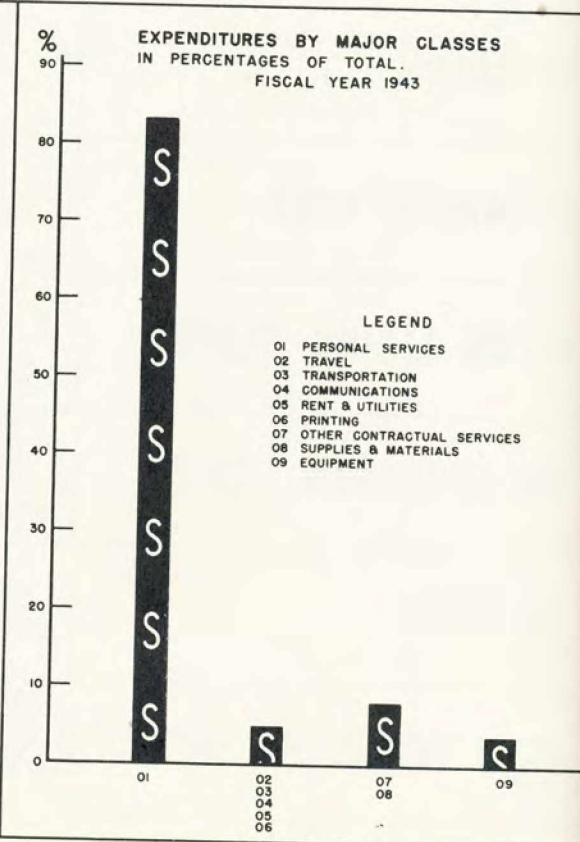
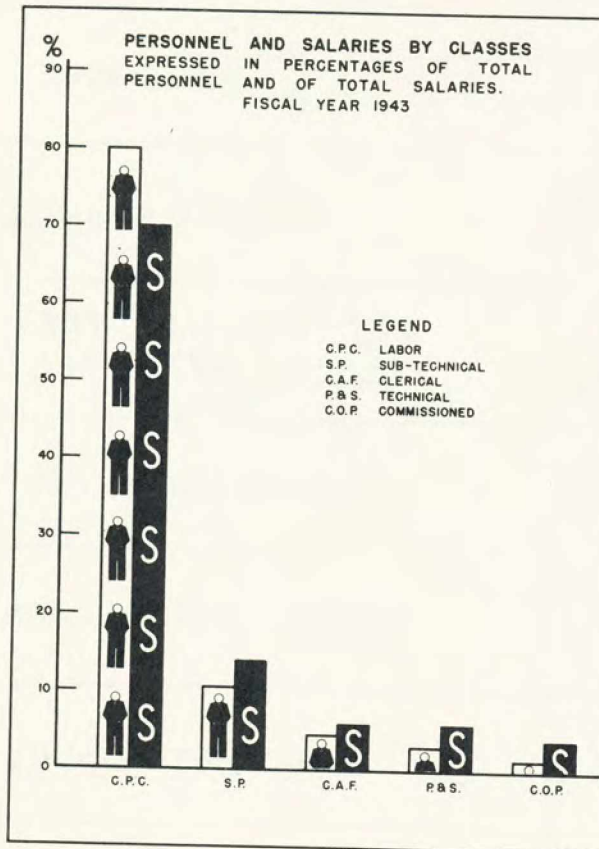
LARVICIDE USED	OIL 	1,876,607 GALLONS
	PARIS GREEN 	152,267 POUNDS
SURFACE TREATED		198,208 ACRES
CLEARING		12,940 ACRES
DITCH CLEANING		4,319 MILES
DITCHING		1,274 MILES
DYNAMITE USED		448,800 POUNDS
DITCH LINING PLACED		37,026 SQUARE FEET 12,534 LINEAR FEET
UNDERGROUND DRAINS		7,005 LINEAR FEET
FILLING		60,009 CUBIC YARDS
MAN HOURS OF WORK		6,250,548 HOURS

MALARIA CONTROL IN WAR AREAS

TYPES OF PROJECTS



July 1, 1943





1161 WAR ESTABLISHMENTS

IN THE UNITED STATES AND PUERTO RICO

WERE PROTECTED FROM

MALARIA

THE NUMBER ONE DISEASE OF WORLD WAR II



MALARIA CONTROL IN WAR AREAS

1942 - 43

PART II

INTRODUCTION

The Malaria Control in War Areas program (hereinafter referred to as MCWA), together with the anti-malaria measures carried out by the Army and Navy within military and naval reservations, has played a large part in preventing the spread of malaria among the armed forces and workers in vital war industries.

Following the declaration of war, funds were allocated to the Public Health Service for direct operation of anti-malaria measures in war areas. Headquarters for this activity were established in Atlanta, Georgia, in March 1942. Operations were at first restricted to an area comprising 15 southeastern States and Puerto Rico, but subsequently 3 States adjacent to the original area were added, as well as the District of Columbia and limited areas on the West Coast.

Intensification of the war effort during the fiscal year 1943 brought ever larger concentrations of military and industrial manpower into potentially malarious areas. Coincident with the increased need for control activities, technical staffs of State health departments were rapidly depleted by transfer to the armed forces. The MCWA program was therefore extended and supplemental personnel was hired and trained.

The incidence of malaria in the United States at the beginning of the war emergency was the lowest in history. The fundamental purpose of the MCWA program was to maintain the low malaria incidence throughout the period of military and industrial mobilization. Specifically, the enterprise was designed to control production of malaria mosquitoes and thus reduce the danger of malaria transmission in extra-cantonment zones and essential war-industry areas. Operation of the projects was through the State health departments.

During the fiscal year 1943 about six and one-half million dollars were appropriated to the Public Health Service to continue operations started during the fiscal year 1942 and to extend control to new areas. The program was complementary to similar control measures undertaken by the Army and Navy inside military and naval reservations. Policy direction was exercised by the Atlanta headquarters office in collaboration with the Public Health Service districts involved.

The organization and operation of the MCWA program was predicated on the concept that effective protection of the armed forces had to be provided with the minimum utilization of manpower and materials. These criteria replaced monetary considerations as the determining factor in deciding the locale and extent of operations.

The MCWA program involves close coordination of the medical, engineering, and entomological services essential to an effective and well-balanced malaria control program.

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Medical Services provide interpretation of morbidity and mortality statistics on malaria, supervision of thick-film blood slide surveys to determine incidence of malaria in and near war areas, consultation on medical malaria problems, and direction of the educational program.

The basis of the program is the control of mosquito vectors, particularly Anopheles quadrimaculatus. Hence, the entomological findings which determine the breeding areas and the density of the vectors, and which check the effectiveness of the control measures, are the governing factors in the institution of new projects and the evaluations of results. Entomological activities resulted in large financial economies through labor curtailment, reduction in the size of areas controlled, and decreased use of larvicides.

The engineer, utilizing entomological and medical data, determines in the field the method or combination of methods best adapted to give effective control; and by means of cost analyses, plans a feasible and economical program. Engineering services include inauguration and operation of control activities, selection and allocation of equipment and supplies, and preparation and approval of engineering plans. Larviciding and minor drainage were the methods chiefly employed to reduce anopheline production. These methods are expedient, economical, and require minimum manpower and equipment. Major drainage was done only where larviciding was impracticable or uneconomical, or where, at a reasonable cost, breeding areas could be eliminated or drastically reduced. Well-planned major and minor drainage programs have already produced substantial savings in manpower, material, and equipment; the effects of this work will be felt even more during the coming season.

In continental United States control within any particular area was restricted to a radius of approximately one mile, the flight range of Anopheles quadrimaculatus (eastern vector) and Anopheles freeborni (western vector). In Puerto Rico control activities were extended over a radius of 2½ miles, the flight range of Anopheles albimanus.

In war areas where the potential malaria hazard was greatest, community educational programs were instituted. These programs were designed to aid in effecting malaria control through individual and community effort in areas beyond the one-mile control zone.

The administrative organization for this extensive program provides close working contact between the headquarters office and the State offices. An administrative assistant and clerical aides were assigned to each State. Engineers and entomologists were detailed to the Public Health Service district offices to assist the State malaria control bureaus with the administrative and technical operation of the program.

OPERATIONS DIVISION

Near the end of the fiscal year an organizational change was made which involved the establishment of an Operations Division, the functional chart of which appears on the opposite page.

In this change the Medical, Engineering, Entomological, and Aedes aegypti Sections, which had previously reported directly to the Executive Office, were combined under an Operations Division for the purpose of correlating and simplifying all the activities relating to mosquito control. At the same time, the functions of professional personnel procurement, allotment of supplies, and Army and Navy liaison, which had previously been handled by a General Service Section under the Executive Office, was also incorporated into the Operations Division. The functions of Army and Navy liaison consist in assuming the responsibility for keeping the Army Service Commands and Naval Districts thoroughly informed concerning the inauguration, termination or progress of control programs being operated in areas surrounding military and naval establishments.

When this change was made, the Medical Section was also divided. That portion of it charged with operational activities such as epidemiological studies and blood surveys was made a section of the Operations Division. The educational functions of the original Medical Section, such as the in-service training and visual education programs, were transferred to the Executive Office.

This change was made late in the year and consequently the section reports are, in some instances, based on the original organizational plan.



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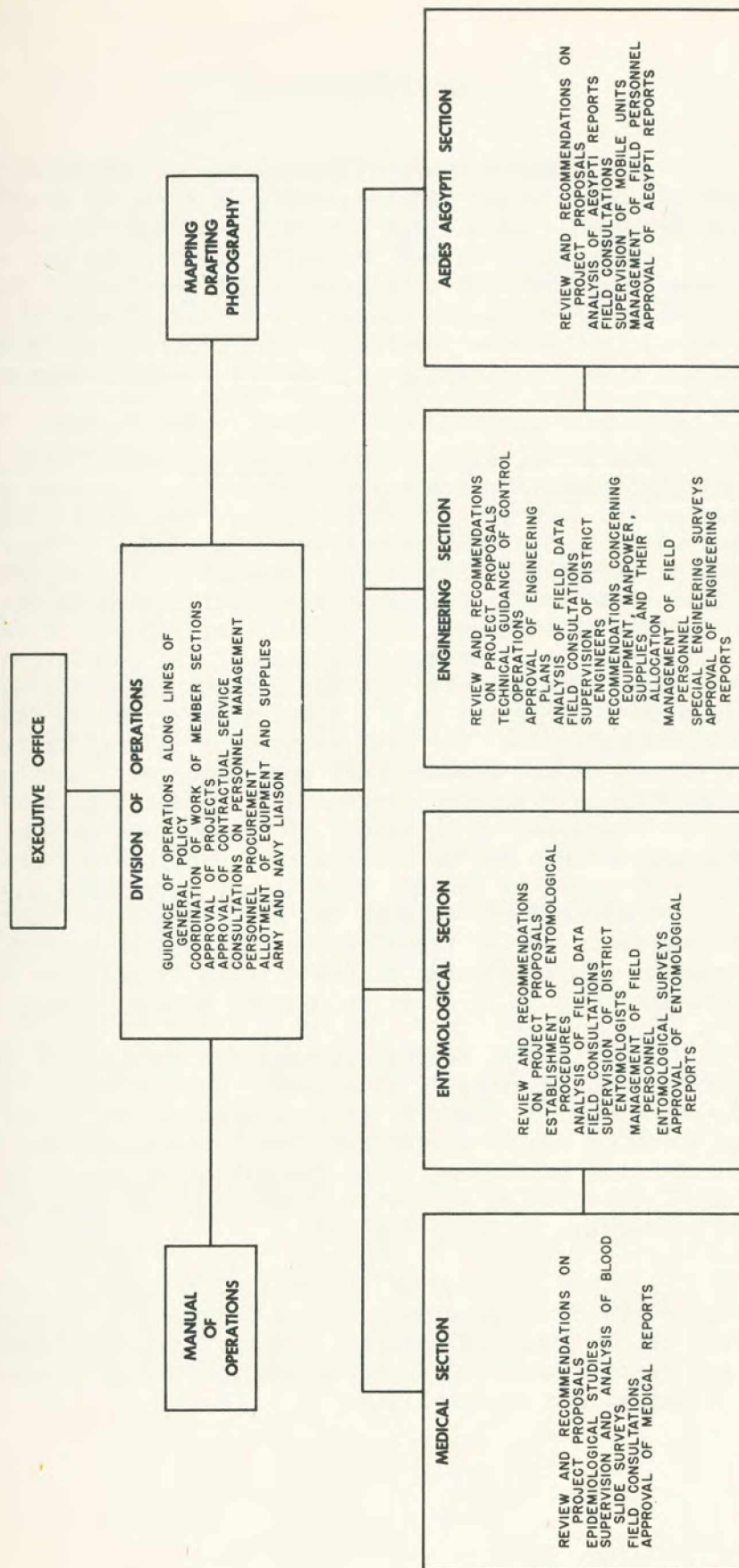
ALS



UNITED STATES PUBLIC HEALTH SERVICE

MALARIA CONTROL IN WAR AREAS

FUNCTIONAL CHART DIVISION OF OPERATIONS



MEDICAL SERVICES

Of the three professions forming an effective malaria control team, the medical group is concerned most directly with the actual disease problem. The medical activities of MCWA do not involve treatment of cases because in the present situation the use of drugs as part of an emergency preventive program is not practical. Since the prophylactic action of available drugs is not sufficiently effective to make them useful in the area covered by this program, the Medical Section has restricted itself to keeping informed of research developments in this field.

The principal function of the Medical Section has been to assemble information which would provide factual bases for appraising the disease hazard in a particular locality. Available information and present techniques do not permit exact knowledge of this kind. In appraising the malaria hazard in a community, the information of most immediate value is the incidence and distribution of malaria cases. The chief sources of such data are statistical reports of cases and deaths, and thick-film blood surveys of groups of the population. Such data alone do not, however, give a clear indication of the malaria hazard; they must be interpreted in the light of every known factor related to malaria transmission. The past history of malaria in the area and the cyclic nature of the disease must be considered. Another factor to be reckoned with is extensive movements of population, such as are now occurring. Hundreds of thousands of persons who have never been exposed to malaria, and who may be considered "susceptibles" are moving into malarious areas; many persons with latent infections (carriers) are moving into areas where malaria has been absent for years but where conditions favorable to transmission exist. The possibility of the introduction of new strains of the disease by military personnel returning from the tropics is of major concern at the present time.

Essentially, medical information permits the designation of areas which are potentially malarious. Whether or not such areas are subjected to control measures is determined on the basis of the density of the mosquito vector as demonstrated by entomological surveys. In some borderline instances, where the potential hazard is difficult to determine, the type of war establishment and the number of persons involved become the deciding factors.

Another function of the medical section is keeping alert to other mosquito-borne disease problems and keeping up generally with progress in the field of malaria. During the year special studies were made and reports prepared on other mosquito-borne diseases -- yellow fever, dengue, and encephalitis.

Blood Slide Surveys

An extensive thick-film survey was made during the year. The blood slide survey is the most practical and reliable method of measuring the prevalence of malaria. Spleen surveys are of limited usefulness. The blood slide survey is a case-finding method which is useful in determining the location of endemic foci. Another purpose of the thick-film blood survey was to establish a base line of malaria prevalence to be used for comparative purposes in subsequent years.

Slides were taken at grammar schools, the student bodies of which included children living in areas protected under the MCWA program. Most slides were collected in September and October. State and local health department facilities were utilized insofar as possible. Slides and supplies were furnished by MCWA and, in some instances, additional personnel was employed to collect slides. State facilities for examining the slides were supplemented by five full-time technicians stationed in Memphis under the supervision of the Malaria Investigations staff. Examination of the slides will be completed by September 1943.

Reporting systems were used which eliminated duplication and minimized clerical work. A total of 120,934 slides were collected in 16 States and the District of Columbia. Of the 104,613 slides examined by the end of June, 218 or 0.21 percent, were positive. (See table I for summary by States and map (figure 1) showing points where blood slides were taken.) All positive cases were referred to the local health officer. Correlation studies of the results obtained are being made.

The results of the blood slide survey support the conclusion that malaria prevalence is extremely low, furnish a base line for future comparison, and indicate the location of some endemic foci.

The percentage of positive slides is too low to permit the use of the survey results in evaluating the control program. Experience this year suggests that unless a marked change in the general incidence of malaria occurs, next year's survey should be confined to fewer, more carefully selected areas, with the use of a more uniform survey procedure.

In several states, subzones in the control areas were described, on an experimental basis, in terms of the variables affecting malaria transmission. These descriptions, when correlated with blood slide survey results, may give a clearer picture of the malaria problem in the various areas. The year's work provided practical field experience for planning sound correlation studies if rates should rise sufficiently for survey results to be statistically significant in evaluating control work directly.

TABLE I

STATES	NO. SLIDES EXAMINED	POSITIVE	NO. COUNTIES
1. Alabama	5456	18	6
2. Arkansas	2023	10	10
3. D. C.	1293	0	--
4. Florida	6368	5	26
5. Georgia	2925	3	11
6. Illinois	2017	0	15
7. Kentucky	6565	7	17
8. Louisiana	2020	10	14
9. Maryland	388	0	3
10. Mississippi	6073	18	16
11. Missouri	7737	6	12
12. North Carolina	13132	12	15
13. Oklahoma	1896	4	4
14. South Carolina	4313	12	14
15. Tennessee	1273	0	5
16. Texas	39459	113	30
17. Virginia	678	0	3
TOTALS	104,613	218 (0.21%)	201

No. taken 120,934 No. not yet examined 16,321 Percentage positive 0.21

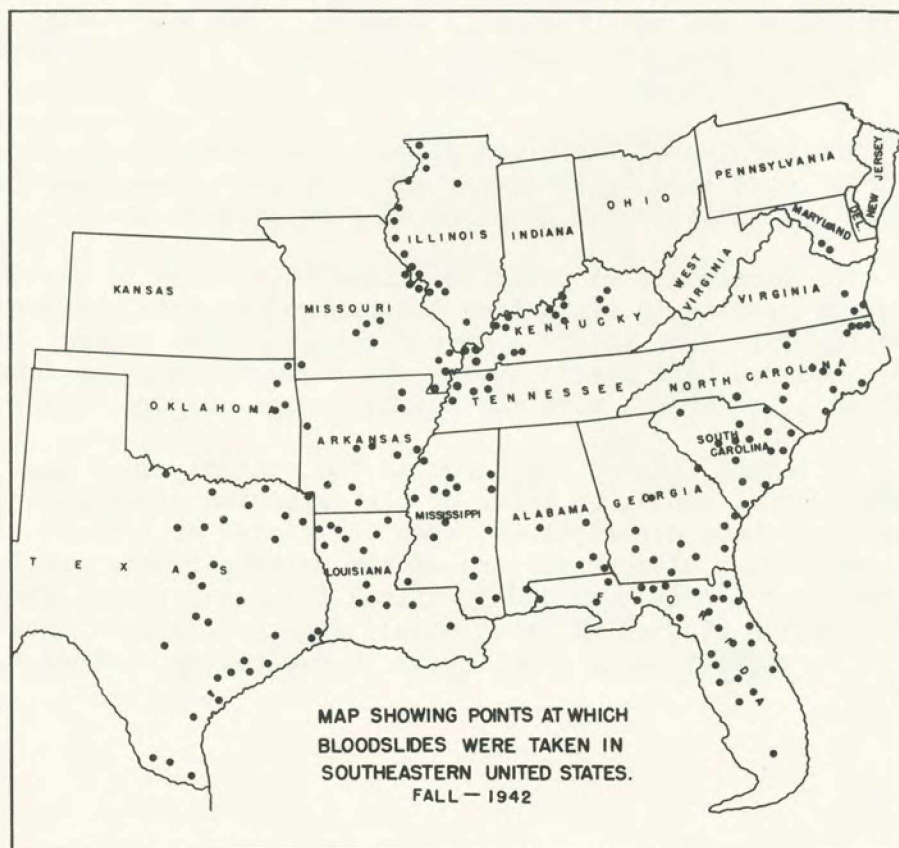


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ENTOMOLOGICAL SERVICES

The principal method of malaria control practiced in the MCWA program is that of attacking the mosquito vector; hence it is essential that the work be based on knowledge of the habits of the specific anopheline concerned. Such an approach is fundamental in any insect control work. Entomological services therefore have been provided for the purpose of gathering and interpreting entomological data for use in guiding mosquito control operations and evaluating results. On the basis of the information provided by these services, the MCWA program was able to effect the following procedures:

1. To limit control work to those localities where density of the vectors was sufficiently high to constitute a malaria hazard.
2. To limit work in such areas to the specific breeding places of the species involved.
3. To limit the frequency of larvicide application so that unnecessary work would not be done.
4. To determine the effectiveness of routine control operations so that supplementary measures or revised procedures could be instituted immediately when indicated.

The benefits to the control program from adequate entomological services have been numerous and varied. Projects of little or no merit which were undertaken in the initial rush of organization have been decreased in size or terminated. New projects are not undertaken in areas where sufficient justification cannot be established; in doubtful cases the area is kept under entomological surveillance until a decision can be made. Savings resulting from this type of analysis have ranged from \$10,000 where small projects were concerned to \$100,000 or more where large operations were involved. When the order of April 1942 was received, allotting a definite manpower quota to the MCWA program, the entomological records of conditions in all the areas where projects were under way or contemplated provided a valuable guide in determining equitable distribution of the manpower allotment.

The vectors of malaria against which control has been undertaken are Anopheles quadrimaculatus in the southern States, Anopheles freeborni on the Pacific Coast, and Anopheles albimanus in Puerto Rico and the lower Rio Grande Valley. Specific control of these anophelines is possible because their habits are rather well known as a result of investigations during recent years. Although the habits of these three species differ to some extent, for the purpose of this report only those of Anopheles quadrimaculatus will be considered.

Anopheles quadrimaculatus is essentially a pond breeder, preferring rather quiet, neutral or alkaline waters containing an abundance of protective vegetation or floating matter. Although it is possible to classify breeding waters on the basis of various environmental factors, it has not been found advisable to attempt such a classification for control purposes. Rather, the



Fig. 2 An Anopheles Breeding Place

specific quadrimaculatus breeding areas have been determined by intensively searching for larvae in all likely breeding waters (figure 2) and identifying any larvae found. This survey work is done, not once, but periodically throughout the season in order to make certain that all active anopheline breeding places are known.

Anopheles quadrimaculatus adults rest during the day (figure 3) in such haunts as barns,

privies, and hollow trees, where cool, dark, quiet conditions exist. The number of mosquitoes found in such places gives a reliable index of their density in the surrounding area, and thus provides a means of gauging the effectiveness of the control work in decreasing the adult anopheline population. Counts of anophelines, therefore, are made periodically in such resting places. Anopheles quadrimaculatus density can also be gauged by the use of mechanical light traps or by supplying and keeping under surveillance artificial resting places; both of these methods have been used to a limited extent in this program.

As the flight range of Anopheles quadrimaculatus under ordinary conditions is limited to about one mile, it is necessary to control breeding only within a one-mile radius of the area in which protection is desired. Therefore, in organizing projects for control or survey purposes the first step is to find all actual or potential breeding areas within a one-mile radius, describe them briefly, and locate them on maps so they can be found easily for subsequent examination and treatment when necessary. A typical set-up for entomological inspection in a control zone is shown in figure 4.

On this map the breeding areas and the points at which adult index records are made are shown by numbers and letters enclosed within symbols. Each of these points is usually a "station." It will be noted that each station number is followed by a



Fig. 3 An Anopheles Resting Place

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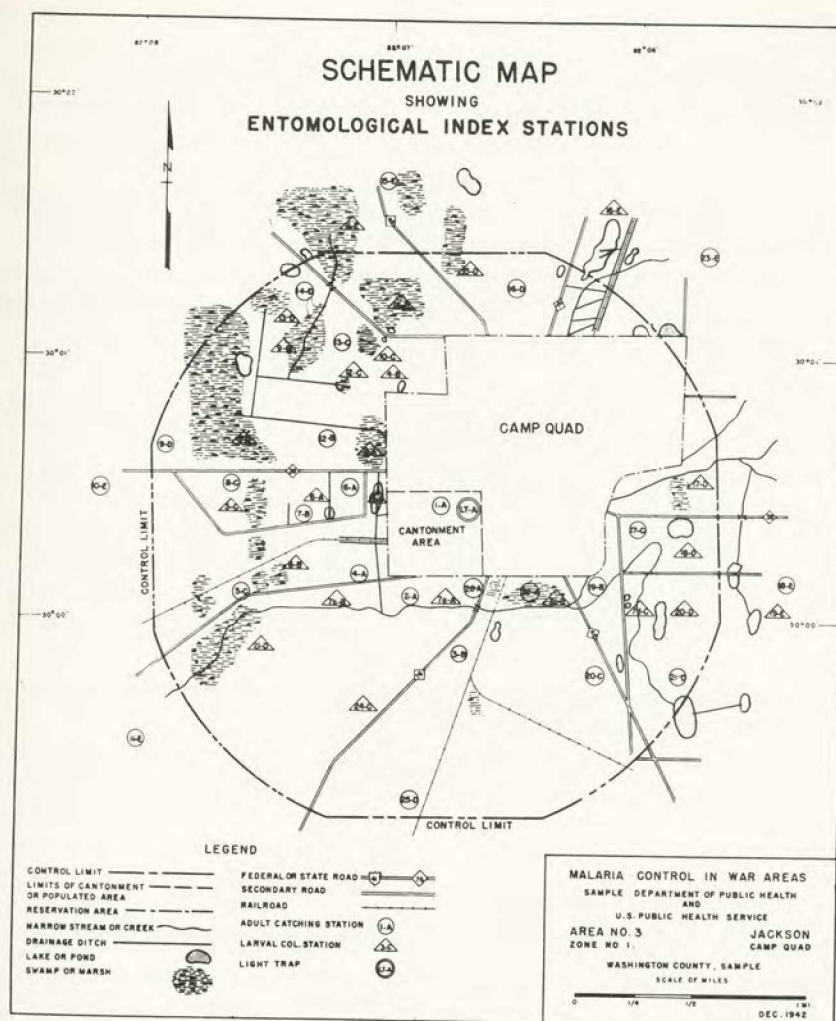


Figure 4

letter, A, B, C, D, or E. These letters are used to indicate roughly the location of the station in relation to the protected establishment. "A" stations are those inside or within 1/4 mile of the protected zone; "B," 1/4 to 1/2 mile; "C," 1/2 to 3/4 mile; "D," 3/4 to 1 mile, and "E," more than 1 mile distant.

A series of forms was devised for reporting the results of entomological inspection work. Form M-1 (figure 5) is used by the inspector for recording his daily observations at the breeding places inspected. Station or location numbers are shown in the left-hand column. The second column is used for any specific information about a station showing a condition other than normal, such as "dry," or "flooded." Station descriptions are not placed on each report, since a list of these descriptions is kept on file for reference. The third column shows the last date when larvicide was applied at each place. The larval collections made are recorded in the remaining columns of the form. Inspections are made two to three days after

State Sample LARVAL MOSQUITO COLLECTION—Field Record

Area 3-Jackson Date July 7, '42 Collector C. Jones Identifier _____

Notes _____

STATION NUMBER	LOCATION OR REMARKS	Last Date Larvicide Applied	No. Dips	ANOPHELES							OTHERS	
				Total	Small	Large	Pupae	quad.	cruc.	punc.	Total	Identified Species
1-A	Zone 1-Camp Quad	7/4	10	40	40						25	<i>Psorophora</i>
2-A		7/4	30	0								
3-C		7/4	30	4	4						8	<i>Psorophora</i>
4-B		6/13	30	20	20						10	"
5-D		7/4	0									
6-A	Dry	6/20	10	25	25						25	<i>Culex</i>
7a-A		7/4	30	25	25						8	"
7b-B		7/3	30	0							6	<i>Psorophora</i>
8-B		-	0									
9-C		7/3	30	0							3	<i>Culex</i>
10-C	Dry	7/3	30	15	15						5	"
11-E		-	10	50	25	15	10				15	"

MCWA-101

U. S. P. H. S. Malaria Control in War Areas

FORM M-1

Figure 5

State Sample ADULT MOSQUITO COLLECTIONS—Field Record

Area 3-Jackson Date July 1, '42 Collector C. Jones Identifier C. Jones

Notes _____

Notes

STATION NUMBER	LOCATION OR REMARKS	ANOPHELES										CULICINES			
		quad.		cruc.		punct.				Total		M	F	Species	
		M	F	M	F	M	F	M	F	M	F				
	Zone 1-Camp Quad														
1-A	NRP		0				1				1		3	<i>P. columbiae</i> <i>A. vexans</i>	
2-A	NRP		1								1				
3-B	NRP		3				7				10		5	<i>P. columbiae</i> <i>A. vexans</i> <i>C. quinque.</i>	
4-A	NRP		0								0				
5-C	NRP		8			2	18			2	26		10	<i>P. columbiae</i> <i>A. vexans</i>	
6-A	ARP		1								1				
7-B	NRP		5								5		2	<i>P. columbiae</i>	
8-C	NRP		10				8				18	1	10	<i>P. columbiae</i> <i>C. quinque.</i>	
9-D	NRP		20								20		8	<i>Culex</i> spp.	
10-E	NRP		8	45						8	45	2	15	<i>P. columbiae</i>	
11-E	NRP		3	30						3	30				
LT-A	LT		1								1		10	<i>A. vexans</i>	

FORM

MCWA-102

U. S. P. H. S. Malaria Control in War Areas

FORM M-2

Figure 6

-44-

treatment, when small larvae usually can be found at each active breeding place. The finding of large larvae or pupae indicates that the previous larvicide treatment was ineffective and that another application should be made at once. It is the inspector's duty to cover adequately the area being examined and report his findings in multiples of ten dips in order to allow for uniform summarization of records.

Abundance of adults in the resting places is reported on Form M-2 (figure 6), which is also a daily report form. In the first column the number of each observation station is given together with the letter A, B, C, D, or E, which designates the station location in relation to the war establishment to be protected. In the second column the type of the station is shown; "NRP" indicates a natural resting place. Barns, stables, privies, and the space under bridges and buildings, are the types of stations most frequently used. "ARP" indicates an artificial resting place, such as a box or keg. These are used when natural resting locations cannot be found. When light traps or animal traps are used the collections are designated as "LT" and "AT," respectively. In the remaining columns of the form the numbers of the different species of anophelines found are shown by sexes. The numbers of mosquitoes other than anophelines are reported in the last column as a matter of general interest.

The inspector gives a copy of the Forms M-1 and M-2 to the area supervisor at the close of work each day and points out to him the areas where important breeding is occurring or where adult densities are high. A logical interpretation of the reports illustrated in figures 4 and 5 would be that adequate control is being maintained. These reports show that the larvae are not reaching maturity in the control zone and that the adult stations within a 1/4 mile of the protected area (stations 1, 2, 4, and 6) have inconsequential numbers of quadrimaculatus adults. The adult mosquito densities in the B, C, and D stations should represent an infiltration of mosquitoes from outside the area under control, while those at E stations, if located at a sufficient distance from the control area, indicate more or less normal mosquito densities for the locality.

At the end of each week the inspector transfers the data from his M-1 and M-2 forms to summary forms M-3 and M-4 (large forms with the same headings as M-1 and M-2) and arranges the records in consecutive order. He forwards these with any specimens needing identification to the State MCWA headquarters. Here the records are reviewed and completed by the addition of identifications, and copies are made for the area, the State and the Public Health Service district office files. This system keeps the various offices advised of conditions in each area.

Because of the large number of official inquiries concerning conditions on MCWA projects, it is necessary that the headquarters office be kept currently informed of the status of each project. To accomplish this a franked postal card report, Form M-7 (figure 7) containing selected entomological data from each zone is prepared and forwarded to Atlanta by the inspector at the time that he prepares the M-3 and M-4 forms.

OTHERS
Identified Species
<i>Anopheles</i>
<i>Anopheles</i>
"
<i>Culex</i>
<i>Anopheles</i>
<i>Culex</i>

FORM
M-1

C. Jones

LICINES
Species
<i>Columbiae</i>
<i>Vexans</i>
<i>Columbiae</i>
<i>Vexans</i>
<i>quinque.</i>
<i>Columbiae</i>
<i>Vexans</i>
<i>Columbiae</i>
<i>Columbiae</i>
<i>quinque.</i>
<i>Culex</i> spp.
<i>Columbiae</i>
<i>Vexans</i>

FORM
M-2

Form M-7 has spaces for reporting the numbers of quadrimaculatus and other vectors found in five "special index 'A'" stations. These adult natural resting stations have been carefully selected as representative of the protected area. These same stations are reported each week so that a continuous record of the fluctuation of densities will be on file in the headquarters office. In addition, the highest "quad" counts in A, B, C, D, and E stations are recorded on the card so that general conditions throughout the locality will be known. Space is also provided on the card for recording information about anopheline breeding conditions which give an idea of the efficiency of control operations. After summaries of the data contained in the M-7's are made at the headquarters office, copies of these

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE—MALARIA CONTROL IN WAR AREAS

WEEKLY ENTOMOLOGICAL REPORT

Sample *3-Jackson 1-Camp Quad* *July 11 '43*

(State) (Area) (Zone) (Week ending)

STATION NO.	SPECIAL INDEX "A" STATIONS										HIGHEST STATIONS									
	1 -A		2 -A		4 -A		6 -A		26 -A		2 -A		7 -B		8 -C		21 -D		18 -E	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Quadrimaculatus	0		1		0		1		0		1		5		10		524		236	
Albomans																				
maculipennis																				

BREEDING PLACE INSPECTIONS

Total number of ABCD stations: *21*
 Number inspected: *21*
 Number with *Anopheles* breeding: *14*
 Number with large *Anopheles* larvae and pupae: *0*
 Maximum collection large *Anopheles* larvae and pupae in 10 dips (ABCD Stations) _____
 Have you discussed mosquito records with area supervisor this week? *Yes*

REMARKS: *Dry this week.* (Name) *C. Jones*
 (Title) *Inspector*

Form 3206 (M-7)
 F. S. A.-P. H. S.-Jan. 1943
 MCWA-107

GPO 16-32877-1

Figure 7

forms are forwarded each week to Army Service Command headquarters for information and comment.

No attempt has been made to establish arbitrarily a definite threshold of quadrimaculatus density as determined by numbers occurring in natural resting places, by which to judge the adequacy of control work. Rather, the effectiveness of the work in any area is gauged by conditions inside a control zone compared to those in similar environments outside. An exception to this is in Puerto Rico where uniform animal bait traps are used and where collections of more than five adults per trap per night are considered indicative of inadequate control.

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In determining the need for anopheline control around war areas in the States which comprise the malaria belt, the presence of even moderate numbers of Anopheles quadrimaculatus in and about the war establishments is taken as justification for control, whereas, in areas outside the malaria belt, the presence of the same or even greater numbers of this species is not considered cause for alarm. Under the latter conditions it is usually recommended that the area be kept under close observation but that no control work be undertaken unless there is evidence of malaria transmission or a notable increase in quadrimaculatus prevalence.

A number of places are under surveillance at present where, on account of previous malaria history, there is a possibility that malaria may become epidemic. There is also the possibility that new strains of the parasite may be introduced by returning troops or war workers. In cases of this kind, careful surveys are made in order to have information available for immediate use if control work should become necessary.

Effectiveness of the MCWA Program

Entomological records received during the 1942 breeding season indicate that MCWA control work was effective in satisfactorily reducing the densities of Anopheles quadrimaculatus in approximately 92 percent of the war establishments protected by the MCWA program. The remaining 8 percent showed periods during the season when anopheline densities were considered to be sufficiently high to create a potential malaria hazard.

This 8 percent was distributed generally throughout the malaria belt in 12 of the 19 states in which work was undertaken, which indicates that the failures were caused by local difficulties rather than by general misunderstanding or technical failures in any one State. Furthermore, the standard of satisfactory control is based on the scarcity of anophelines throughout the entire protected area, and therefore dangerous densities in any one portion would cause the entire zone to be designated as unsatisfactory.

In the main, the failures fell into two categories: (1) Poor technique such as inefficient larviciding and inspection, and (2) unavoidable cases such as (a) overwhelmingly large breeding areas involving difficult control problems, e.g., rice fields, extensive impoundments, and flooded areas caused by abnormal rains; (b) delay in starting of control, and (c) the necessity for major drainage operations for adequate control.

Quadrimaculatus densities throughout the 1942 season, in those zones where continuous comparable records are available to indicate conditions outside as well as inside or adjacent to the protected war activities, are illustrated in figure 8. Here it is shown that at the beginning of the season the densities were higher inside the protected areas than outside, but that as the control work progressed and all the troublesome breeding spots were located, the inside densities were maintained at a low level for the remainder of the season. It is particularly significant that inside densities did not reflect the considerable rise which occurred outside during the late summer.

Reports received to date for the 1943 mosquito season (May-June) indicate somewhat higher average vector densities in control areas than during the corresponding months in 1942. The percentage of zones in which satisfactory control is being maintained, however, stands at about 94 percent, or slightly higher than for the 1942 season. The same observations as made

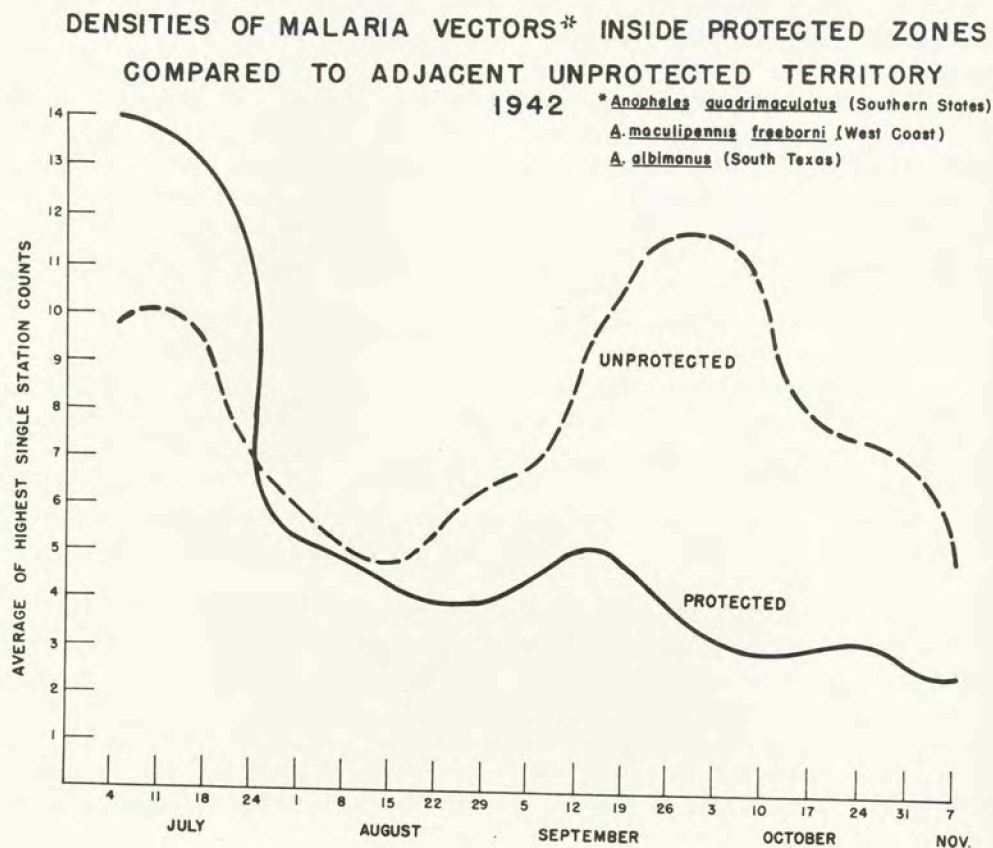


Figure 8

the 1942 records concerning the distribution of unsatisfactory zones and the reasons for the high densities of mosquitoes present apply equally well to these early 1943 season records.

Special Entomological Survey Work

At the request of various war agencies special entomological surveys were made during the year at war establishments in various parts of the country. The chief purpose of this work was to determine the abundance of the malaria vector, *quadrimaculatus*, and whether or not it was advisable for the to institute control. Further work of this nature around a number of northern war locations is planned for the coming summer, particularly at Army and Navy hospitals where troops returning from tropical countries are quartered.

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In New England during 1942, at the request of the Surgeon General of the Army, such surveys were made at Portland and Presque Isle, Maine; Chicopee Falls and Ayer, Massachusetts; Portsmouth, New Hampshire; and Narragansett, Rhode Island. In all of these areas very little evidence of hazardous densities of quadrimaculatus was found, the mosquitoes causing concern being of the pest varieties. Ayer, Massachusetts, is reported to have a malaria history, and because of the importance of this war area, and the presence of an Army general hospital, further survey work will be undertaken during the 1943 season.

At the request of the Surgeon General of the Navy, detailed mosquito surveys, including plans and estimated costs for control work, were made around the following places:

Potomac River Naval Command (Md. and Va.)
New River Marine Base (N.C.)
Banana River Naval Air Station (Fla.)
Parris Island Marine Base (S.C.)
Corpus Christi Naval Air Station (Texas)

Philadelphia Navy Yard (Pa.)
Cherry Point (N.C.)
Key West (Fla.)
Charleston Navy Yard (S.C.)
New Orleans (La.)

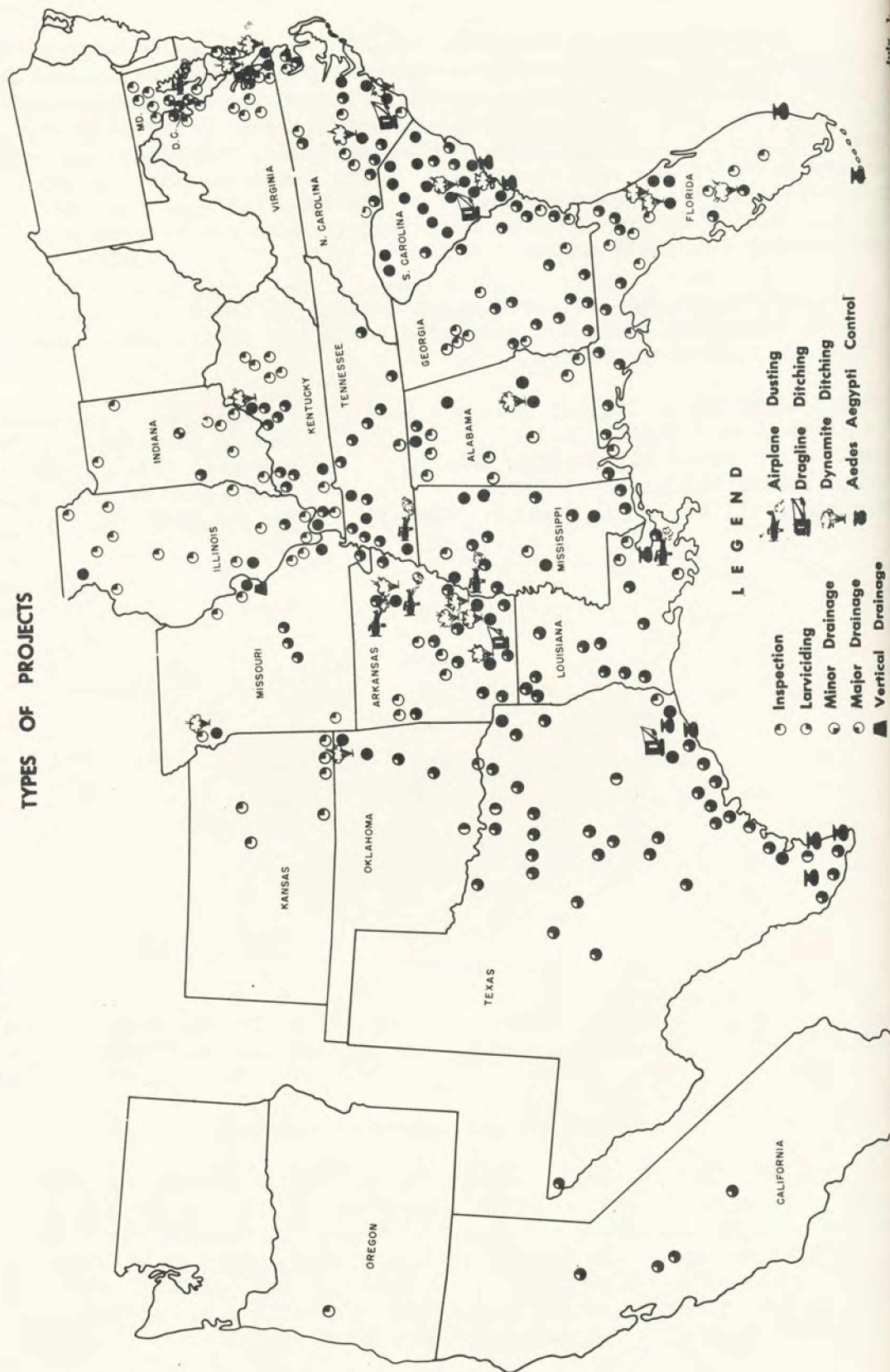
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U. S. PUBLIC HEALTH SERVICE

MALARIA CONTROL IN WAR AREAS

TYPES OF PROJECTS



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ENGINEERING SERVICES

The malaria control engineer, utilizing entomological and medical data, decides on the method of attack, puts it into effect, and furnishes the technical supervision necessary for the successful conduct of the work. In the MCWA program, the functions of the Engineering Section are:

1. To make the necessary engineering surveys.
2. To decide on the most feasible and economical plan of operation.
3. To initiate control work.
4. To guide the control operations so that they function efficiently and effectively.
5. To handle, at the area and State level, the operational and executive details necessary to the smooth functioning of the program.

During the fiscal year 1943 the methods generally used for control of malaria in territories adjacent to Army, Navy, and industrial war establishments were: (1) Destruction of mosquito larvae by larvicides; (2) elimination of mosquito breeding areas by drainage or filling; and, (3) killing of adult mosquitoes by spraying.

Project proposals, originated by State health departments, covered three types of activities:

1. Larvicidal and minor drainage projects which utilized periodic larvicidal applications to control production of the malaria vector. Minor drainage and clearing operations incidental to, and necessary for, the efficient operation of the larvicidal program were performed as part of these projects. Where insecticidal spraying for the control of engorged adults was utilized, it was included under this type of project.
2. Major drainage and clearing projects which depended on drainage, clearing, or filling as the major factor in achieving control of anopheline breeding.
3. Inspection projects in which no larvicidal or drainage work was indicated at the time but for which entomological and/or medical observation were deemed necessary to determine whether control should be instituted. Inspectional services varied from regular routine inspection at weekly intervals to occasional inspections.

The application of larvicides is the primary method of control used in this program. Although this is somewhat contrary to the usual

practice in normal malaria control operations in which main reliance is placed on control by drainage and filling, the emergency nature of this program and the temporary character of most of the war establishments being protected, made it advisable to use larvicides to control anopheline production where effective control could be achieved by such measures.

Larvicidal Operations

Petroleum oil and paris green were the two larvicides most commonly used, although some pyrethrum emulsion and phenol were employed. During the year 1,876,607 gallons of oil and 152,267 pounds of paris green were used. Since paris green dusted on the water is toxic only to anophelines, while oil kills all mosquito larvae, oil was more generally used. Table 2 presents data on the amounts of larvicides used and the extent of cumulative water surface treated by individual States.

TABLE II

MOWA LARVICIDE AND MINOR DRAINAGE PROJECTS

FISCAL YEAR, 1943

STATE	Maximum No. Areas	Maximum No. War Establishments Protected	LARVICIDAL WORK			OTHER WORK			Water Surf. Eliminated Acres	Total Man Hours
			Larvicide Used		Surfaces Treated Acres	Ditching Lin.Ft.	Cleaning Lin.Ft.	Clearing Acres		
			Oil Gals.	Paris Green Lbs.						
Alabama	14	64	10,906	---	472	74,172	151,395	49	69	85,223
Arkansas	17	63	53,894	7,100	9,650	230,334	992,298	1,076	437	299,221
California	4	11	26,024	---	2,511	46,513	254,401	144	147	30,267
D. C.	1	23	1,790	---	23	116,941	66,428	9	12	41,663
Florida	22	91	40,634	3,306	9,365	961,484	2,643,794	235	1,879	411,609
Georgia	17	93	311	11,492	15,120	220,323	898,244	852	51	257,391
Illinois	14	54	6,406	1,352	598	3,645	8,495	84	4	23,316
Indiana	9	40	2,088	1,294	101	6,765	9,550	27	26	21,920
Kansas	7	17	---	---	---	---	---	---	---	---
Kentucky	6	48	23,138	---	2,077	25,286	355,313	115	25	96,203
Louisiana	9	56	829,057	15,444	61,846	553,084	1,460,287	1,019	584	821,759
Maryland	4	21	42	---	1	40,423	119,311	21	24	36,544
Mississippi	14	50	57,097	26	1,202	132,706	843,393	723	93	214,765
Missouri	7	24	7,515	320	1,164	11,205	76,335	160	36	50,676
North Carolina	13	69	103,602	---	3,647	463,200	2,606,169	979	213	355,425
Oklahoma	5	21	16,528	---	1,039	87,589	566,062	287	46	94,229
Oregon	1	1	---	---	---	---	---	---	---	---
Puerto Rico	9	22	13,910	78,674	39,353	929,880	2,132,352	183	183	636,046
South Carolina	23	101	202,142	1,652	12,296	402,549	3,902,650	2,636	459	505,753
Tennessee	10	69	95,634	785	3,310	97,756	372,210	367	49	140,543
Texas	14	140	330,368	1,497	13,143	796,471	2,900,251	1,669	1,070	527,279
Virginia	6	83	55,500	26,995	21,280	546,902	559,911	976	34	270,790
Total	226	1,161	1,876,607	152,267	198,208	5,749,480	20,981,049	11,671	5,441	4,993,444

* Inspection only.

The larvicides were applied by means of hand sprayers or dusters

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	Total
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69	85,223
437	299,221
147	30,267
12	41,863
679	411,609
51	257,391
4	23,316
26	21,920
25	96,833
584	821,759
24	36,544
93	214,765
36	50,878
213	355,425
46	94,229
183	636,046
459	505,753
49	140,543
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34	270,790
441	1,993,444

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Fig. 9 Power Duster in Operation (5 H.P.)

larvicidal oils secured through Treasury Department procurement schedules and other contracts to insure satisfactory larvicidal qualities.

Late in August 1942 it became necessary to larvicide approximately 3,500 acres of prolific A. quadrimaculatus breeding area within flight range of important war establishments near Washington, D.C. This breeding occurred in the water-chestnut infested areas of the Potomac River and its tributaries. The dense growth of this plant

precluded power spraying or dusting from boats. It was therefore decided to control this area by means of airplane dusting with paris green. Operations were conducted at Pohick Bay, Accotink Bay, Dogue Bay, Gunston Cove, and Holloway Point. Dusting was started on August 20 and completed on September 26. During this period a total of 19 tons of paris green mixture was used.

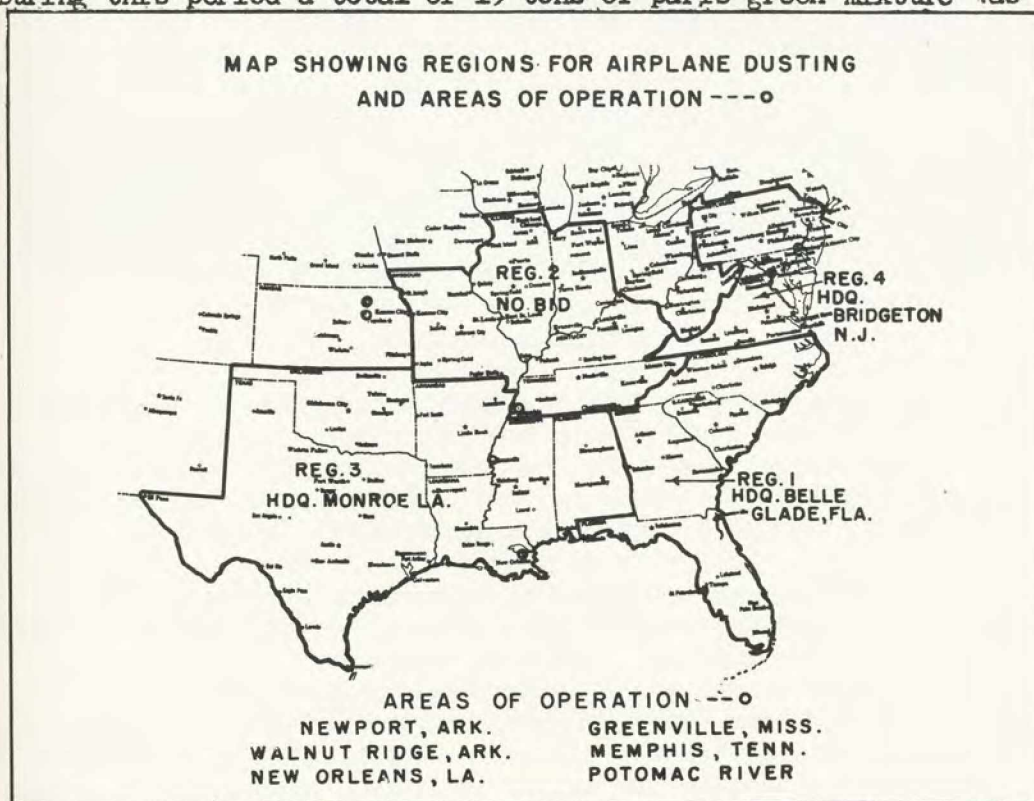


Fig. 10 Airplane Dusting Regions

After the inauguration of this control work, quadrifaculatus densities rapidly declined.

Preparations have been made to use airplane dusting more extensively during the 1943 season. The malarious areas of the United States have been divided into four regions and contracts made with commercial airplane dusting companies for work in three of the four regions (figure 10). No bids were received for work in region 2, but the States included are on the northern fringe of the malarious belt where there is less likelihood of need for airplane dusting.



Fig. 11 Airplane Dusting on Wolf River Backwater, Memphis, Tennessee

By June 30, 1943, four airplane dusting projects were in operation. These were located near New Orleans, Louisiana; Newport, Arkansas; Walnut Ridge, Arkansas; and Greenville, Mississippi. Operations will begin during the first week of July, 1943, in the Potomac River water chestnut area and on another project near Memphis, Tennessee.

Minor drainage and clearing operations incidental to the prosecution of larvicidal control were carried on with the same personnel used for spraying and dusting. Breeding areas were kept under close inspection and only places actually breeding "quads" were larvicided. A variable number of man-hours not needed for larvicidal or clearing work was available each week and was utilized for the digging of relatively small, open earth ditches which served to reduce the magnitude of the breeding area.

1. Larviciding
 - (a) Oil sprayed, gallons
 - (b) Paris green dusted, lbs
Diluent used 153
 - (c) Other *Pyrethrum*
 2. Entomological Inspection Serv
 3. Minor Drainage and Clearing
 - (a) Ditching, lineal feet
 - (b) Ditch cleaning, lineal
 - (c) Clearing, square feet
 - (d) Other
 4. General Supervision (inclu
excluding Inspectors), ma
 5. TOTAL MAN-HOURS (Total
 6. Miscellaneous
 - (a) Total number of me
 - (b) Field time lost becau
 - (c) Water surface elimin
 - (d) Maximum period be
 - (e) Zones larvicided
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- REMARKS: * Gallons

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MALARIA CONTROL IN WAR AREAS
FOR THE ARMY (MCWA 301)
PUBLIC HEALTH SERVICE
March 1943
605 Volunteer Building
ATLANTA, GEORGIA

State Sample
Area Jackson
Project (Key) 7(1)
From May 1 to May 15, 1943

PROGRESS REPORT—LARVICIDING AND MINOR DRAINAGE

	AMOUNT	SURFACE TREATED		MAN-HOURS
		Ditches or less (Lin. Ft.)	Ditches, Ponds, etc., over 4' (Sq. Ft.)	
1. Larviciding				
(a) Oil sprayed, gallons	50	117,924		87
	415		3,578,196	207
(b) Paris green dusted, lbs. (not mixed)	45	379,800		115
Diluent used 3530 lbs.	125		5,125,000	180
(c) Other Pyrethrum Emulsion	50*		522,720	30
TOTAL		479,724	9,225,916	619
2. Entomological Inspection Service, man-hours				40
3. Minor Drainage and Clearing				
(a) Ditching, lineal feet	210	1100		816
(b) Ditch cleaning, lineal feet		15,000		310
(c) Clearing, square feet		41,500		175
(d) Other				
TOTAL				1301
4. General Supervision (including General Foremen, Aides, and Engineers, excluding Inspectors), man-hours				160
5. TOTAL MAN-HOURS (Total 1-4 inclusive)				2120
6. Miscellaneous				
(a) Total number of men employed (average)	23			men.
(b) Field time lost because of rain	30			man-hours.
(c) Water surface eliminated by incidental ditching	95,000			sq. ft.
(d) Maximum period between larvicidal applications	9			days.
(e) Zones larvicided	1, 3, 4, 5			
(f) Zones minor drainage	1, 5			
(g) Zones inspection only	2			
REMARKS: * Gallons of concentrate stock emulsion				

Note—This form is to be used for ALL work included under larvicidal project proposals.

CERTIFIED CORRECT

John Doe, Ass't. P. H. Engineer

Area Supervisor

U. S. GOVERNMENT PRINTING OFFICE 16-50846-1

Fig. 12 Sample Progress Report
Larviciding and Minor Drainage

Class A. Projects in areas where drainage is necessary for adequate control.

Class B. Projects in areas where larvicidal control may be adequate but is expensive, and where drainage is more economical.

Class C. Projects in areas where larvicidal control is adequate and economical but where drainage is part of the long-range control program and where local conditions warrant drainage work.

Major drainage was limited to those areas where effective control could not be achieved by larviciding and where the cost of effective larviciding was so great that drainage was obviously more economical. Such work was not undertaken where it would result in competition for essential industrial and agricultural labor, or for critical equipment.

Before major drainage projects could be instituted, it was necessary that project proposals (figure 13) be submitted supported by a plan and profile (figure 15), a quantity estimate (figure 14), a statement of status of easements, a concise project narrative, and clearance from other Governmental agencies involved.

During the fiscal year 1943, 1,090 miles of minor ditching were completed, resulting in the elimination of 5,441 acres of breeding surface. The substantial saving of manpower and critical materials resulting from this work enabled MCWA to undertake control measures without increased appropriation in the many new or enlarged areas which required protection.

In addition, 3,975 miles of stream and ditch banks were cleared and 11,671 surface acres were cleared of aquatic vegetation. Data concerning the minor drainage work done in the various States during the year is presented in Table 2.

Major Drainage

Major drainage projects are classified as follows, in order of priority:

-56-

8—Non-Labor Costs:

(a) Equipment			
Cars	2	@ \$4/day	50 days \$ 400.00
Trucks	1	@ \$5/day	50 days 250.00
Concrete Mixers	1	@ \$4/day	10 days 40.00
Rubber Boots	20	@ \$5/pair	100.00
Small Tools	30	men @ \$5/man	150.00
Total Equipment Cost			\$ 940.00
(b) Materials and Supplies			
Cement	270	sq. @ \$1.00/sq.	\$ 270.00
Sand	30	c. y. @ \$1.50/c. y.	45.00
Gravel	50	c. y. @ \$2.25/c. y.	62.50
Gas and Oil (Lump Sum)			1000.00
Office Supplies (Lump Sum)			200.00
Contingency Fund	30	men @ \$1/man	30.00
Total Cost Materials and Sup.			\$ 1607.50
(c) Other Non-Labor Costs			
Care and Maintenance of Equipment			\$ 200.00
Total Other Non-Labor Costs			\$ 200.00
(a) + (b) + (c) TOTAL NON-LABOR COST			\$ 2747.50

9—Estimated duration of project 2 months.

Page 2 of 2

Fig. 13 Sample Portion of Project Proposal

Malaria Control in War Areas
U.S. Public Health Service

QUANTITIES ESTIMATE
FOR MAJOR DRAINAGE PROJECT PROPOSAL

State _____
Project Albany #4
Date of Proposal Jan. 1, 1943
Unit No. 1

1. New Ditching:

A. Hand	100 Lin. Ft.
	<u>200 Cu. Yds.</u>
B. Machine	_____ Lin. Ft.
	_____ Cu. Yds.
C. Dynamite	500 Lin. Ft.
	<u>780 Cu. Yds.</u>

2. Ditch Lining:

A. Monolithic	100 Lin. Ft.
B. Pre-cast	_____ Lin. Ft.
C. Masonry	_____ Lin. Ft.

3. Underground Drains:

A. Tile	_____ Lin. Ft.
B. French	<u>200</u> Lin. Ft.

John Doe
(Signed)

Job Description:

This job consists of the construction of 800 lin. ft. of French drain together with considerable clearing. The swamp is located at the south end of Camp Quad and the ditch runs through part of the reservation. That portion of the ditch which runs through the reservation adjacent to the barracks is to be lined. It is estimated that this ditch will drain a 20 acre swamp into the Chicago Creek and thus entirely eliminate larviciding operations. The swamp is located approximately 400 feet from the barracks area.

Easements:

All necessary easements have been secured and are on file in the State Health Department.

Fig. 14 Sample Quantity Estimate Sheet

Fig. 13 Sample Portion of Project Proposal

Fig. 14 Sample Quantity Estimate Sheet

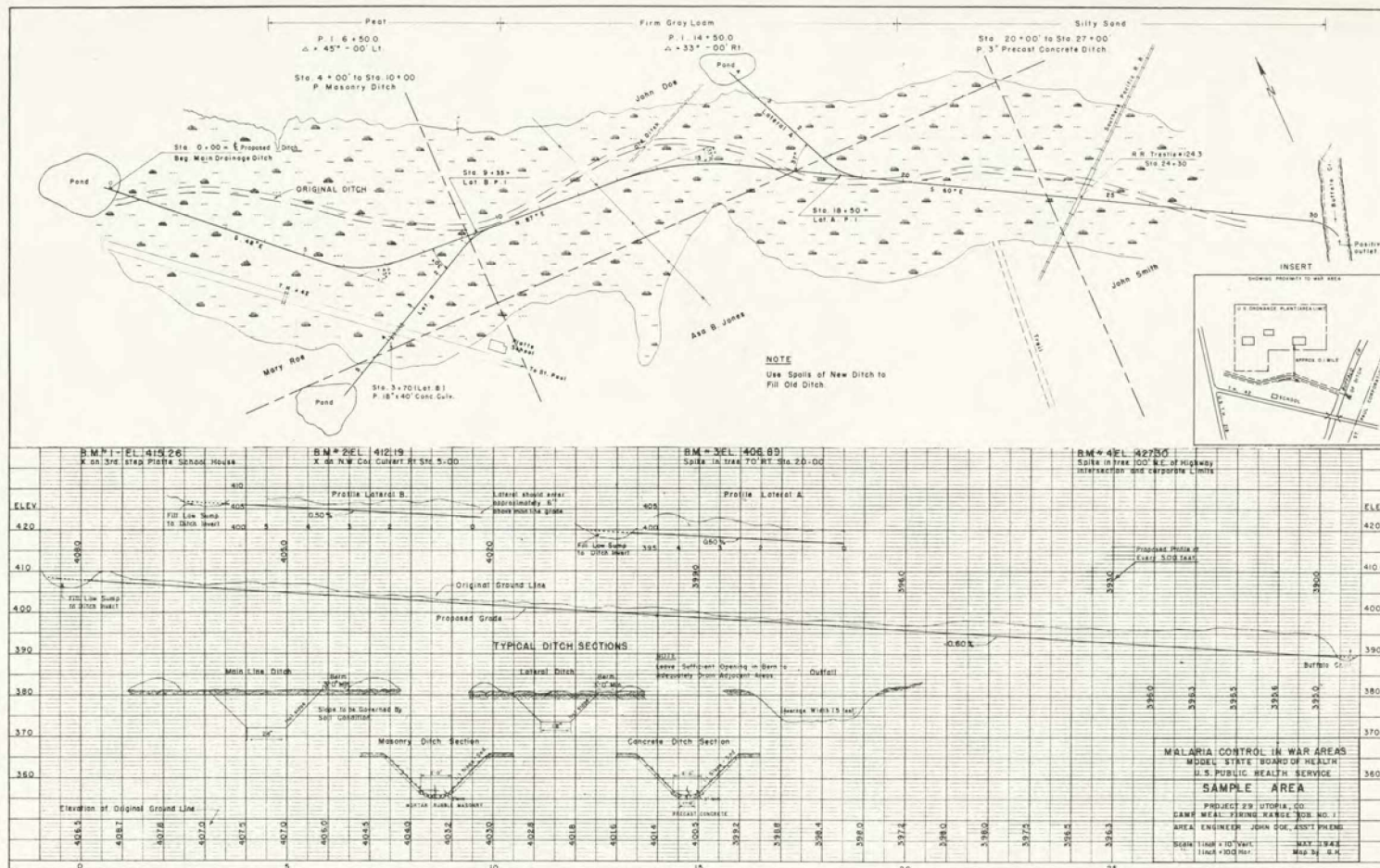


Fig. 26 Essentials of a Malaria Control Map

Although the States usually complete the necessary maps, the headquarters office has prepared in exigencies approximately 360 maps from source material furnished wholly or partially by the States.

MALARIA CONTROL IN WAR AREAS
605 Volunteer Building
ATLANTA, GEORGIA

State Sample
Area Jackson
Project (key) D 5 Unit 3
From May 1 to May 15, 1943

PROGRESS REPORT—MAJOR DRAINAGE AND CLEARING

	Amount	Man-hours
1. Clearing or Brushing, acres	1.15	107
2. Channel or Ditch Cleaning, lineal feet	7656	275
3. New Ditching (main ditches and laterals, excluding lining):		
a. Hand	776	1218
Lineal feet	300	
Cubic yards	3295	180
b. Machine	2985	
Lineal feet	60	
Machine-hours	1400	75
c. Dynamite	1200	
Lineal feet		
Cubic yards		
4. Precast Ditch Lining Prepared (not placed)		
(thickness in.) Square feet completed	1160	48
5. Ditch Lining Placed		
a. Concrete, square feet	780	
b. Masonry, square feet	300	
c. Other, square feet		
d. Ditch lining placed, lineal feet	* 225	25
6. Underground Drainage		
a. Tile drain, lineal feet		
b. French drain, lineal feet	675	175
7. Fill (area 15,000 sq. ft.)		
a. Cubic yards	3126	69
b. Truck-hours		
c. Machine-hours	33	
8. Sodding or Seeding		
a. Sodding, square feet	150	16
b. Seeding, square feet		
9. Miscellaneous Work Done		
a. Removing stumps, each	37	137
b.		
c.		
10. General Supervision (including engineers, aides, general foreman), man-hours		115
11. Total man-hours (1 to 10, inclusive)		2440
a. Total men employed (professional, subprofessional, and custodial)	26	men
b. Field time lost because of rain	21	man-hours
c. Water surface eliminated by major ditching and fill	15	acres

REMARKS: 150 lin.ft. of precast concrete and 75 lin.ft. of brick and mortar

masonry. Unit within one month of completion.

NOTE:—Submit separate report for each major drainage unit.

CERTIFIED CORRECT:

Form 8886 (MAY 1943)
PUBLISHED BY THE
PUBLIC HEALTH SERVICE
(March 1943)

John Doe, Assistant F. H. Engineer

Area Supervisor

Fig. 16 Sample Progress Report
Major Drainage and Clearing.

- The grade was so flat that a smoothly lined ditch was necessary for proper functioning.
- The grade was so steep that ditch lining was necessary to prevent erosion or scouring.
- The ditches formed part of the control system of a permanent establishment, town, or other community where malaria control will be required after the war and where the materials for the ditch lining were contributed locally.

On a number of major drainage projects, machinery and power equipment were used for construction of main outlet channels. In most instances, draglines

Wherever available, WPA labor and other resources were utilized for major drainage work. An average of 2,205 WPA employees were engaged in this work under the technical supervision of MCWA personnel. A considerable number of drainage projects were completed; a few, not finished when WPA ceased operations, were completed with MCWA personnel.

Hand labor, dynamite, and draglines were used for drainage work. Generally, drainage was effected by means of open earth ditches. This method was used because the work was of an emergency nature and required a minimum of labor and materials. Furthermore, many of the war establishments are of a temporary character.

The use of concrete, brick, or masonry inverts was restricted. Such durable ditch linings were used only where:



Fig. 17 Dragline Ditching

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and other heavy construction machinery were employed on a rental basis. Some equipment of this type was secured by transfer from other federal agencies. In some instances the War Department supplied heavy equipment for digging the main outlet canal in extra-cantonment zones.

During the spring of 1942 a disastrous tornado hit the Pryor, Oklahoma, war area, destroying houses and uprooting trees, many of which were blown into Pryor Creek. Subsequent heavy rains flooded the area and floated many more trees and much debris into the stream, thereby causing many small impoundments and creating "quad" breeding places within the town of Pryor. Attempts to control breeding through the application of larvicides during the 1942 season were not completely effective. Power equipment was utilized on this project. By using snatch blocks, the largest logs were removed from the stream bed. Many of the stumps and other debris were removed by dynamite. The length of the stream was approximately 8.6 miles, from which a total of 49,000 cubic yards of drift was removed and burned. The breeding places were eliminated.

Dynamiting is known to be an economical method of ditch construction in suitable situations. The use of this material in the MCWA program has been encouraged wherever applicable, because of the speed and economy with which it can be utilized.

Dynamite is readily available and little skilled labor is needed for its use. Depending on soil conditions, a crew of 3 to 10 men can blast from 750 to 3,000 linear feet of ditch per day. It is expected that dynamite will be used even more extensively during the next fiscal year. The efficiency and economy of dynamite ditching is clearly illustrated by the following examples:

In July, 1942, the first MCWA dynamite project for construction of ditches was started at Pine Bluff, Arkansas. The project involved the construction of 12,000 linear feet of dynamite ditching and 1,500 linear feet of hand ditching. Approximately 18,000 pounds of 50 percent



nitro-glycerine dynamite were used on the project. The cost break-down at the completion of this project showed a unit price of 38 cents per linear foot of ditch and 29.2 cents per cubic yard of excavation. A considerable amount of clearing and incidental work which is not ordinarily encountered made these unit costs somewhat higher than usual. The cost of hand ditching would have been about one dollar per cubic yard.

Fig. 18 Dynamite Ditching

An interesting example of malaria control drainage was provided by a situation at Jerome, Arkansas. Directly across the highway from the Japanese Relocation Center was a 233-acre impoundment known as Ward's Brake. The entire area was a potential quadrifasciatus breeding ground. Due to the unusual condition of the lake (shown in figures 19 and 20) it was extremely difficult, if not impossible, to control breeding by larvicidal measures. The only feasible methods of control were by airplane dusting or drainage. Investigation indicated that drainage was the most practical method of control.

The project was started on January 18 and completed on May 3 by the use of a dragline and dynamite. The job consisted of removing 53,774 cubic yards of earth by dragline at a total cost of \$16,362, and the construction of approximately 15,000 linear feet of dynamite ditch at a cost of approximately \$3,665. Figure 20 is a picture of Ward's Brake completely drained.

At Miami, Oklahoma, a ditch 4,650 linear feet long, 3 feet deep, 6 feet wide at the top and 2 feet wide at the bottom, was constructed with dynamite in only two days. An average of 1.33 cubic yards of earth were moved per pound of dynamite.

A major drainage project was started by the WPA at Walterboro, South Carolina, in November, and in January a dragline was assigned to this project. By the end of March only $1\frac{1}{2}$ miles of ditch had been completed. Test shots indicated the feasibility of completing the project with dynamite, and blasting was started in April. Two months later the project was completed. It would have required about eighteen months to finish the job with the small dragline available.

Another drainage project for the control of about 1,500 acres of breeding area located near Norfolk, Virginia, was completed with dynamite at a total cost of approximately \$8,000. The cost of doing this job with power equipment had previously been estimated at \$80,000.

During the year 448,800 pounds of dynamite costing \$55,671 have been used on projects operating in Florida, Alabama, Arkansas, Kentucky, South Carolina, North Carolina, Virginia, and Oklahoma.

Prior to November 1942, underground drainage was rather loosely included under the general term "drainage" in drainage progress reports. Since that time this activity has been reported separately. From January 1 to June 30, 1943, 7,005 linear feet of underground drains were constructed. With the increasing shortage of manpower for larvicidal work and ditch maintenance, it is expected that underground drainage will become a considerable factor in the program for the fiscal year 1944.

Underground or French drains are easily constructed and well adapted to the MCWA program. Satisfactory drains may be constructed of tile, brickbats, rock, gravel, or poles, all of which are covered by a layer of leaves, straw, or other filter material and backfilled with earth (figures 21 and 22). Properly constructed drains of this type are



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Fig. 19 Ward's Brake - 233 acres of Anopheles quadrimaculatus breeding area located 600 feet from the main entrance of a Japanese Relocation Area - Jerome, Arkansas



Fig. 20 Ward's Brake - three months later after completion of a combination dragline and dynamite major drainage project

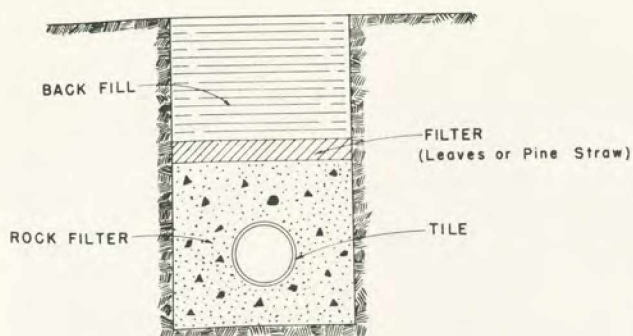


Fig. 21 Underground Tile Drain

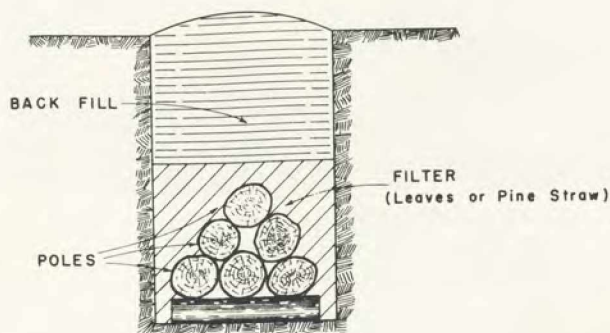


Fig. 22 Underground Pole Drain

lowest portions of swamps and ponds can be filled to ditch elevation, thus making it possible to drain the area effectively.

At Jefferson Barracks, Missouri, when efforts to drain a six-acre sink hole just outside the reservation failed, written permission to attempt vertical drainage was secured from the Sanitary Engineer of the State health department. A vertical shaft was sunk and in a relatively short period of time effective drainage was secured. The cost of this project to MCWA was only \$770. The military authorities furnished approximately \$1,000 in cash, material, and labor.

At Jerome, Arkansas, during the construction of the ditch to drain Ward's Drake, it became necessary to lower the elevation of a monolithic culvert since its

inexpensive to install and require little or no maintenance. Some systems of this type have been reported to give satisfactory service after more than 30 years of use. These systems are particularly efficient in eliminating swamps and marshes produced by seepage outcrops, for subdraining concrete inverts and open earth ditches, stabilizing ditch banks draining marshes caused by springs, and providing outlets for overflowing artesian wells. Also they are often more acceptable to property owners than are large open-type ditches.

Elimination of mosquito breeding places by filling has been effectively utilized in the MCWA program. In several instances municipalities have assisted MCWA crews in this work. Street sweepings, tin cans, garbage, and other refuse can be used to great advantage for this work when utilized in conjunction with major or minor drainage projects. For example, the

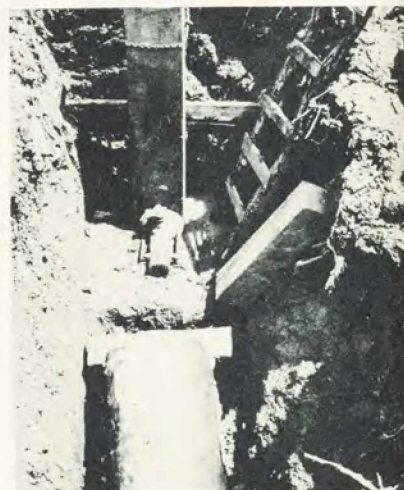


Fig. 23 Hydraulic Jack and Deadman - Jerome, Arkansas

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Fig. 24 Cofferdam on Culvert Jacking Project - Jerome, Ark.



Fig. 25 Culvert Jacking Project Completed - Jerome, Ark.

flow line was 5.8 feet above the proposed grade. Because it was not possible to dig up the roadbed, it was decided to use a hydraulic jack to force a 24" x 42' steel culvert through the roadbed underneath the monolithic culvert. A concrete headwall was constructed on both sides of the culvert. Although flood waters and the presence of old concrete under the floor of the culvert added to the difficulty of the job, the total cost of the operation was \$548, of which \$370 was for labor and \$178 for material. Figures 23, 24, and 25 show steps during construction.

During the fiscal year 1943, 68 major drainage projects were in operation in 13 States and Puerto Rico. About 184 miles of new ditch were constructed, 77 percent by hand, 18 percent through the use of dynamite, and 5 percent with draglines. A total of 1,257,104 man hours of labor were expended on major drainage projects. A tabular summary on the major drainage program by States is presented in Table 3.

STATE	Maximum No. of Projects	Clearing Brushing Acres	Channel or Ditch Cleaning Lin. Ft.	New Ditching Lin. Ft.			Fill Cu. Yds.	Ditch Lining Paved		Under-ground Drains Lin. Ft.	Total Man Hours
				Hand	Machine	Dynamite		Sq. Ft.	Lin. Ft.		
Alabama	3	49	7,858	53,958	---	10,004	2,610	---	---	---	102,552
Arkansas	4	127	30,139	27,885	---	60,295	302	---	---	62	24,824
Florida	2	21	24,600	---	---	45,000	---	---	---	---	26,966
Illinois	3	19	39,019	15,825	---	---	---	---	---	---	13,605
Kentucky	4	10	9,000	29,325	---	1,825	574	---	---	---	36,550
Mississippi	5	7	6,860	112,000	---	---	10,342	7,642	1,514	1,590	52,956
Missouri	3	6	1,150	3,990	---	---	56	---	---	---	7,374
North Carolina	4	454	1,027,297	211,516	35,000	244	20,566	354	126	237	236,312
Oklahoma	3	---	7,274	10,637	---	22,576	166	---	---	---	17,442
Puerto Rico	2	37	13,250	10,600	---	---	395	---	---	---	255,445
South Carolina	19	475	496,443	170,312	6,100	32,740	22,394	16,582	6,241	4,642	393,794
Tennessee	3	42	10,700	43,367	---	---	967	1,438	1,275	---	27,765
Texas	10	5	34,810	30,106	3,689	---	1,593	---	---	6	43,646
Virginia	3	17	55,892	15,297	---	14,960	---	10,940	3,376	160	21,397
Total	66	1,269	1,524,602	733,646	44,789	187,644	60,009	37,026	12,534	7,005	1,257,104

Insecticidal Control

Throughout the 1942 malaria transmission season, a program for destruction of adult *Anopheles quadrimaculatus* was conducted at Stuttgart, Arkansas, where this vector was breeding abundantly in the extensive rice fields. Since ordinary control methods applied to this large area would have been excessively expensive in relation to the number of people to be protected, it was determined to institute a program of house-to-house spraying on an experimental basis. The houses were sprayed twice weekly with a pyrethrum spray. The aim of the program was to kill engorged mosquitoes during the parasite development period, thus preventing possibility of malaria transmission. This project is being repeated during the 1943 breeding season.

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nd	Total Men Hours
	102,882
	24,824
	26,986
	13,405
	36,450
	52,956
	7,374
	232,512
	17,442
	254,405
	393,794
	27,765
	43,648
	21,397
	1,257,104

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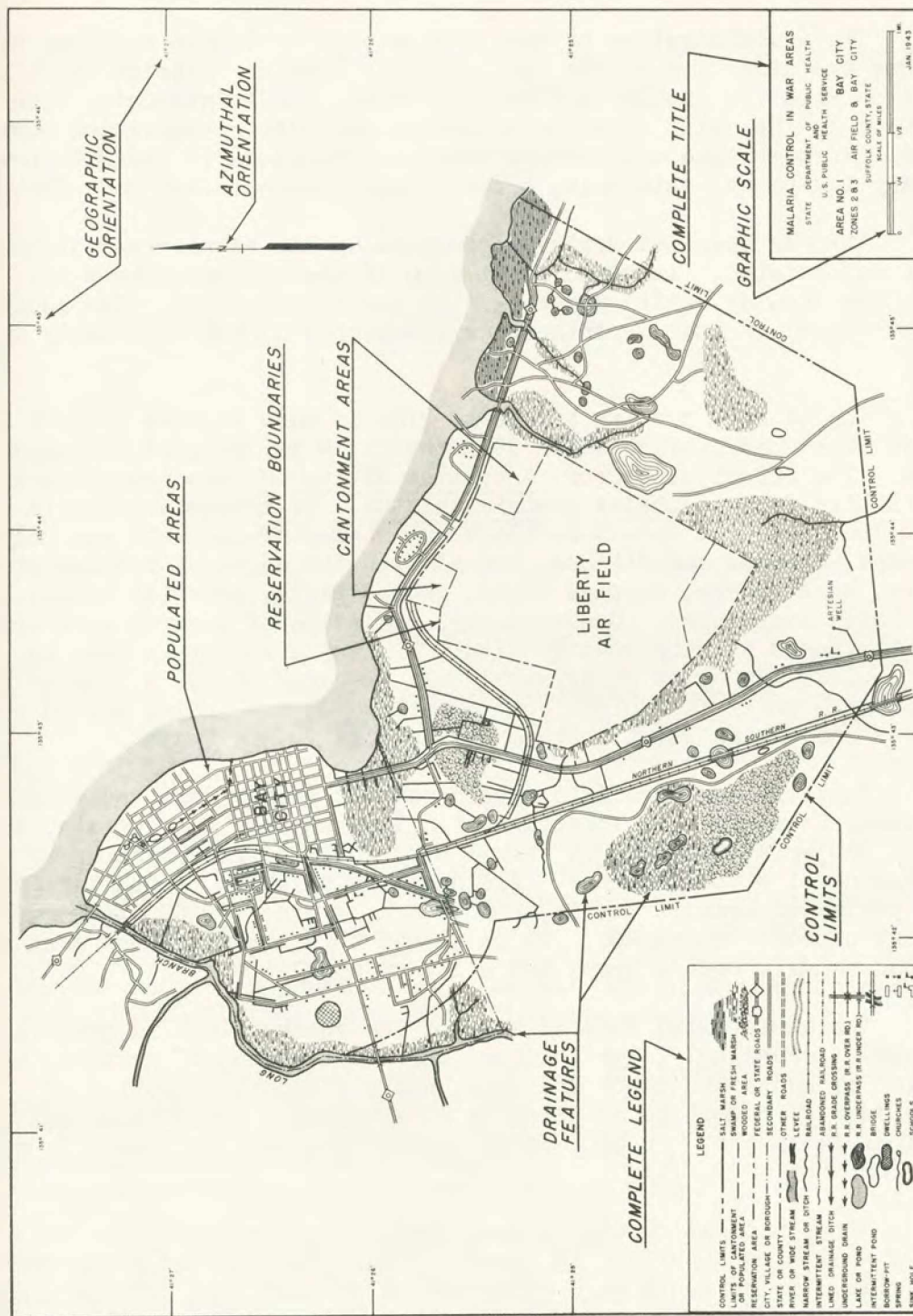


Fig. 15 Sample Plan and Profile For Major Drainage Project

Figure numbers and titles on
pages 57 and 65 reversed

MCWA IN PUERTO RICO

The administration of the MCWA program in Puerto Rico was established under the direction of the Public Health Service District No. 6 in collaboration with the Insular health department. MCWA integrates with the Army and Navy in the joint planning of intra- and extra-reservation control activities. Through this cooperation there is available to the MCWA program the military equipment, materials, office space, quarters and mess facilities.

The WPA operated drainage projects in the extra-reservation areas under MCWA supervision. Larviciding at some of the military bases was started by the Insular health department as far back as 1940. The equipment and some personnel of that department were assigned to the MCWA early in the program.

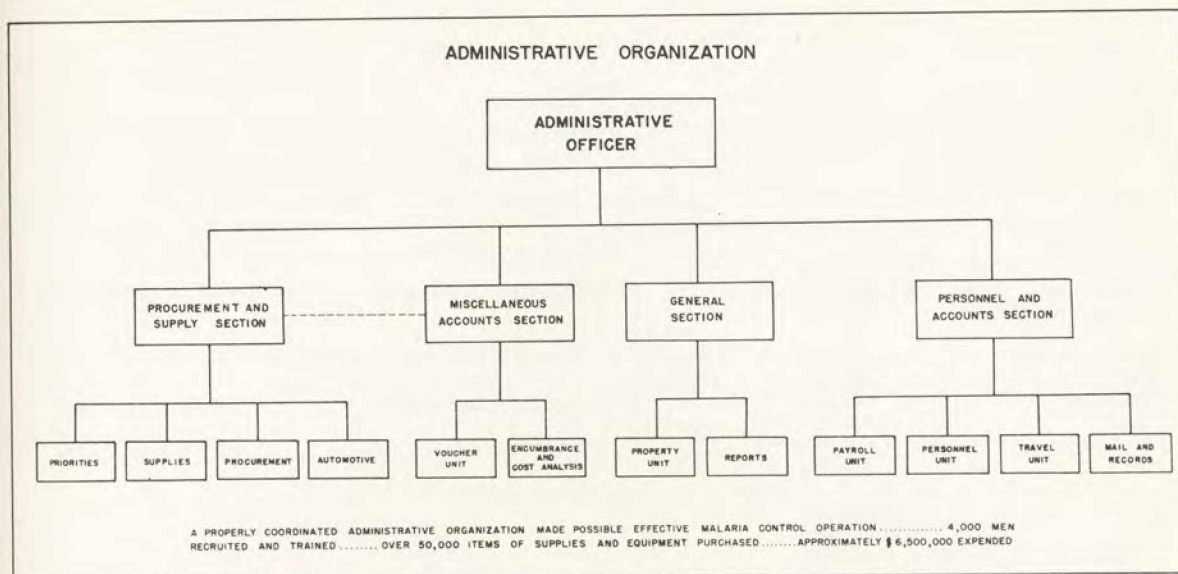
The malaria problem in Puerto Rico is more complex than it is in the States. The mortality rate for 1941 was 124.9 per hundred thousand population. The principal vector, Anopheles albimanus, has considerably different habits from Anopheles quadrimaculatus. It transmits malaria throughout the year. It breeds in almost all types of habitats not only in ponds, swamps, marshes and ditches, but also in the edges of running streams, hoof prints, cart tracks, seepage areas, ground pools, brackish waters, and even artificial containers. Consequently, the scope of control work against Anopheles albimanus is much greater within similar sized areas than is necessary against Anopheles quadrimaculatus. Because it has a greater flight range, the areas under larvicidal control extend $2\frac{1}{2}$ to 3 miles beyond protected areas and are at least 4 times as large as in the States.

Tactical and strategic considerations rather than environmental health hazards determine the locations of military bases. At present there are 10 MCWA projects operating in Puerto Rico for the protection of 21 military and naval establishments. Although the majority of military population is protected against the malaria hazard, a minority has temporary duty in many unprotected places. It is within this minority that most of the residual malaria occurs among the military population.

The anticipated life of some of the reservations is temporary or uncertain. Accordingly, larviciding, the chief method of control, is supplemented by major and minor drainage, where adequate reduction of anopheline density cannot be obtained by other means. Paris green has been the principal larvicide. In some cases it was necessary to resort to airplane dusting.

Since natural resting places have not proved suitable for determining Anopheles densities in Puerto Rico, animal baited traps were used primarily. Experiments were conducted which show that suction light traps are adaptable to this purpose and may be used where electric current is available. The density of Anopheles albimanus during 1943 was only 3 percent of that recorded for the 1942 season. For June 1943, at four of the more important military establishments, the incidence of malaria, including relapses, was only about 20 percent of the same period for 1942.

ADMINISTRATIVE DIVISION



Administration of the MCWA program is under the control of the Executive Office, which is responsible to the States Relations Division of the Public Health Service. Besides the headquarters office of MCWA in Atlanta, Georgia, there are 20 additional offices in the United States which handle MCWA administrative matters for the individual States. In addition, there is an office in Puerto Rico.

Men and materials must be provided when and where necessary, and without delay. During the year the Administrative Division of the headquarters office was charged with the responsibility of recruiting more than 4,000 men and procuring more than 50,000 items of equipment and supply, in addition to more than 300 tons of lime, 140 tons of paris green, and 1,900,000 gallons of larvicides. The shortage of manpower and the problem of priorities added to the difficulties of these tasks.

Adequate location records of all property, classified as to types, were kept to insure proper maintenance, usage, and control. Approximately 500 automotive vehicles, mostly trucks, were in use during the year. The administrative task of keeping these vehicles operating was increased by the application of gasoline and tire rationing.

The accounting system for the control of all funds, except payrolls and travel, was simplified during the latter part of the year to insure adequate encumbrance records, monthly cost analysis statements, and prompt payment of vouchers.

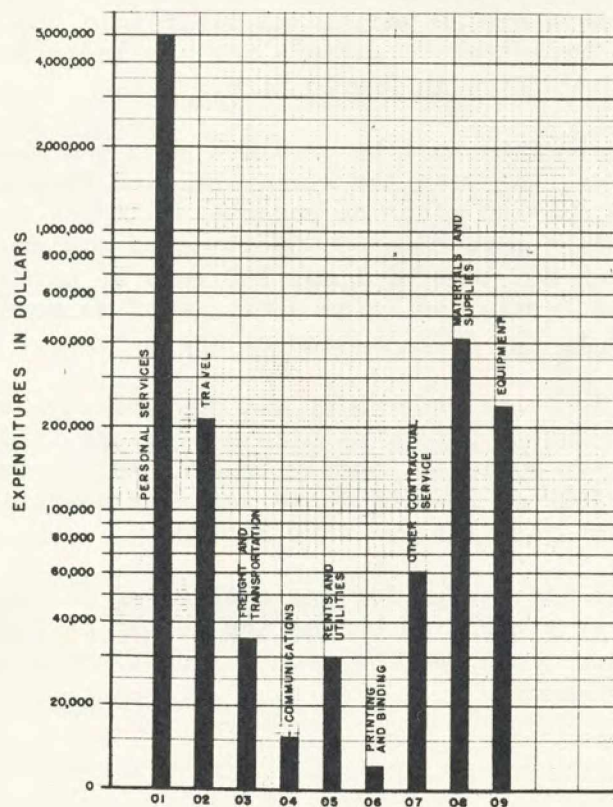
TABLE IV

MCWA EXPENDITURES FOR FISCAL YEAR 1943
(Pro-rated to the nearest thousand)*

BY STATES			BY BUDGET OBJECTS		
Name of State	Amount	% Total	No. and Name of Object	Amount	% Total
Alabama	\$188,000	3.0	01 Personal Services	\$5,092,000	83.0
Arkansas	371,000	6.1	02 Travel	228,000	3.7
California & Oregon	67,000	1.1	03 Transportation	35,000	0.5
District of Columbia	49,000	0.8	04 Communications	12,000	0.2
Florida	619,000	10.1	05 Rents, Utilities etc.	29,000	0.5
Georgia	254,000	4.1	06 Printing, Binding	12,000	0.2
Illinois & Indiana	93,000	1.5	07 Other Contractual Services	64,000	1.0
Kentucky	137,000	2.2	08 Supplies and Materials	425,000	6.9
Louisiana	898,000	14.6	09 Equipment	243,000	4.0
Maryland	55,000	0.9			
Mississippi	268,000	4.4			
Missouri & Oklahoma	179,000	2.9			
North Carolina	557,000	9.1			
South Carolina	922,000	15.0			
Tennessee	179,000	2.9			
Texas	691,000	11.3			
Virginia	294,000	4.8			
Puerto Rico	319,000	5.2			
Totals	\$6,140,000	100.0		\$6,140,000	100.0
Transferred to EH & SA	327,000			327,000	
Totals	\$6,467,000			\$6,467,000	

* The amounts shown above include costs of the following, pro-rated proportionately:
Headquarters and Districts, Departmental Personal Services, Community Health Education, Blood Slide Survey.

EXPENDITURES FOR THE FISCAL YEAR, 1943



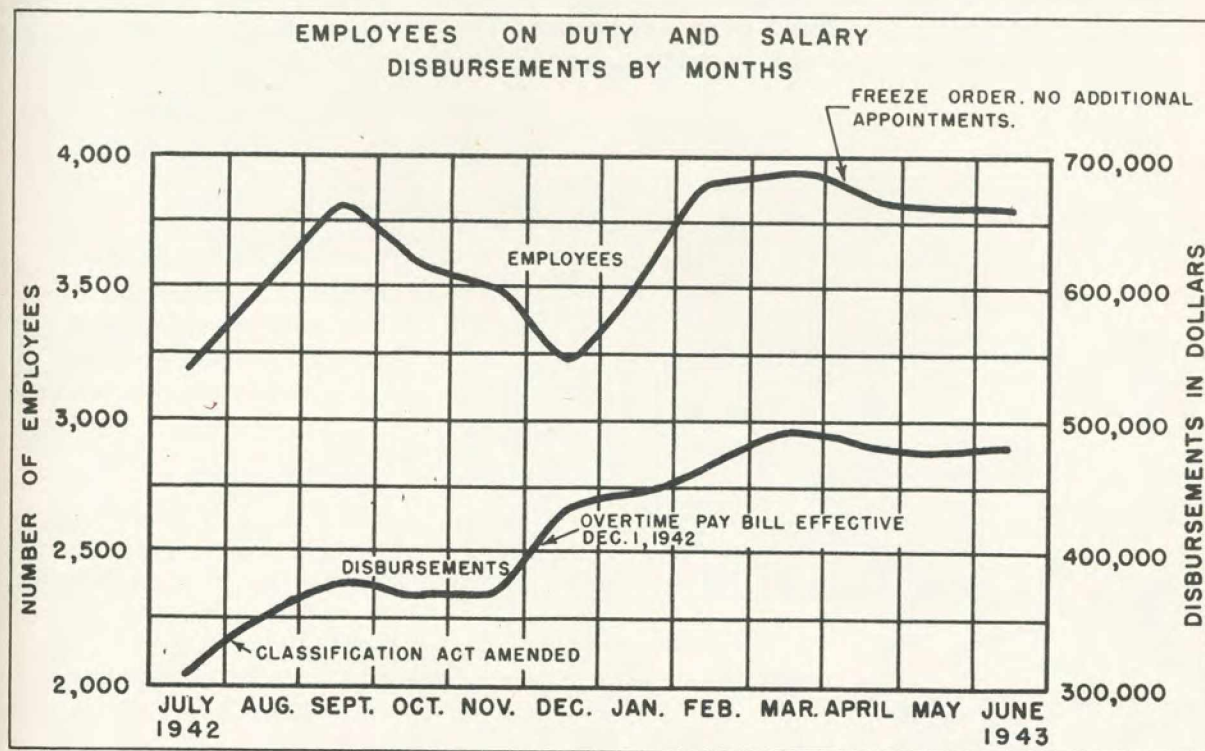
Total
85.0
3.7
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1.0
6.9
4.0
100.0

Slide Survey.

PERSONNEL AND ACCOUNTS

The Personnel and Accounts Section, composed of the Personnel, Payroll, and Travel Units, controls the flow of men and money for the MCWA program. Through its relationship with State administrative offices, this section handles administration relating to recruitment, appointment, and promotion of personnel; controls travel authorizations; and directs the preparation and handling of payrolls. During the year expansion of this section was necessary to do the increased work in connection with payroll allotment plan for War Bonds, personnel ceilings, and income tax deductions. High labor turnover in the most critical war areas also was a major problem.

Approximately \$5,000,000 was expended during the year for the payment of salaries, and about \$200,000 for travel and the movement of house-



hold effects. The trend of personnel and salary expenditures by months during the fiscal year 1943 is indicated on the above graph.

Employees were encouraged to continue and increase their participation in the War Savings Bond Campaign. Reports indicate that 77 percent of MCWA employees are allotting 7.5 percent of their earnings to the purchase of War Savings Bonds.

PROCUREMENT AND SUPPLY

The Procurement and Supply Section is responsible for the acquisition of supplies, materials, and services other than personal services. Approximately \$900,000 was expended during the year for these items.

In view of the magnitude of the program, strict control over the flow and distribution of supplies and materials to locations in the field was imperative. A reserve stock of the more common items of equipment and tools was procured during the year from curtailed Federal agencies and located in the central warehouse in Atlanta for allocation to the States as needed.

The Automotive Unit of this section was responsible for the administrative work in connection with the MCWA fleet of over 500 vehicles. Among the tasks involved were assignment and maintenance of vehicles, gasoline rationing, accident reports, and issuance of courtesy cards.

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SPECIAL PROJECTS AND COOPERATIVE ENTERPRISES

AEDES AEGYPTI CONTROL PROGRAM

Yellow fever, the dreaded "Yellow Jack" of the tropics, becomes an ever-increasing menace in the southern United States with the return of military personnel from fever-ridden areas. A large portion of these service men disembark from planes rather than ships. This gives rise to the complicating factor of speedy travel in relation to the incubation period of the disease and the additional hazard of plane-carried living *Aedes aegypti* mosquitoes which may be infected. Military planes which land at airports where quarantine services are maintained receive attention equivalent to that

INSPECTION



given commercial airliners; but many planes land at military airbases where quarantine services are lacking.

The history of dengue fever in this country is characterized by intermittent sudden outbreaks of considerable extent with almost complete prostration of the affected communities. Two of the most recent outbreaks were the epidemic in southern Florida in 1934 which involved several thousand cases, and the epidemic in Hidalgo County, Texas, in 1941 in which an estimated two thousand cases occurred. Undoubtedly, the disease simmers in areas close to our southern borders and shores where there is a year-round breeding of the insect vector, *Aedes aegypti*. Dengue, too, could easily be introduced by military personnel returning from endemic sections of the world.

Aedes aegypti mosquito control, therefore, is a most important public health measure. It is especially important from the standpoint of successful prosecution of the war. South Atlantic and Gulf Coast ports of entry daily receive the influx

CORRECTION



EDUCATION



of homeward bound men returning from infected areas. These ports are also centers of heavy military concentration and vital industrial activity. If complete eradication of the infestation cannot be attained economically in these places, the least that should be done is to lower the aegypti population to a level of relative safety.

The Aedes aegypti index, a figure indicating the percentage of inspected premises on which breeding was found, is used as the criterion of aegypti incidence and as a guide to control operations. Multiple breeding places on a single premise may contribute to a heavy mosquito population in the immediate vicinity, but because of the limited flight range of aegypti (75-100 yards), wide geographical distribution, as evidenced by a high index on many premises, is much more dangerous from the epidemic standpoint. Five percent is the empirical threshold which has received general acceptance as the point above which there is a danger of individual cases of disease serving as epidemic foci.

Prior to the establishment of the MCWA program, title VI funds were allotted through the Public Health Service and the State health departments to a few municipalities for the control of Aedes aegypti. In order to consolidate all mosquito control programs of the Service under one direction, responsibility for the existing aegypti control programs was assigned to Malaria Control in War Areas.

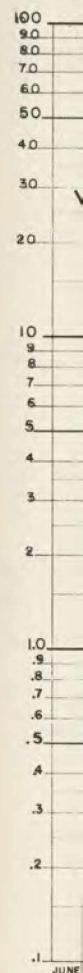
In addition to the programs which were already being conducted at Charleston, South Carolina, and Miami, Florida, and which served as nuclei out of which operations were subsequently extended to other places, a demonstration eradication program was instituted at Key West, Florida. Key West was chosen because of its high aegypti population, its past history of yellow fever, its military importance, and its isolated position which augured well for its protection from re-infestation should eradication prove practical.

Four areas in Texas -- Houston, Galveston, Corpus Christi, and Brownsville -- were originally selected, and small additional control units were later added at San Antonio and in Hidalgo County. Here the emphasis was placed chiefly on public education. In addition, spot surveys were made at Beaumont, Orange, and Port Arthur, which showed such low indexes that no further activity, other than a late-season survey (1943), is contemplated. Savannah, Georgia, was selected as a site of operations for a mobile unit. Two mobile units were assigned to New Orleans for a short survey and incidental correction. Eleven municipalities were under survey and incidental control at the end of the fiscal year. Except for the Florida cities, public education plays a large part in the control program.

Aegypti Control Through Public Education

There are two main schools of thought in aegypti control, both of which are predicated on the presence of tropical conditions. Both agree that the only solution to the aegypti problem is eradication, the

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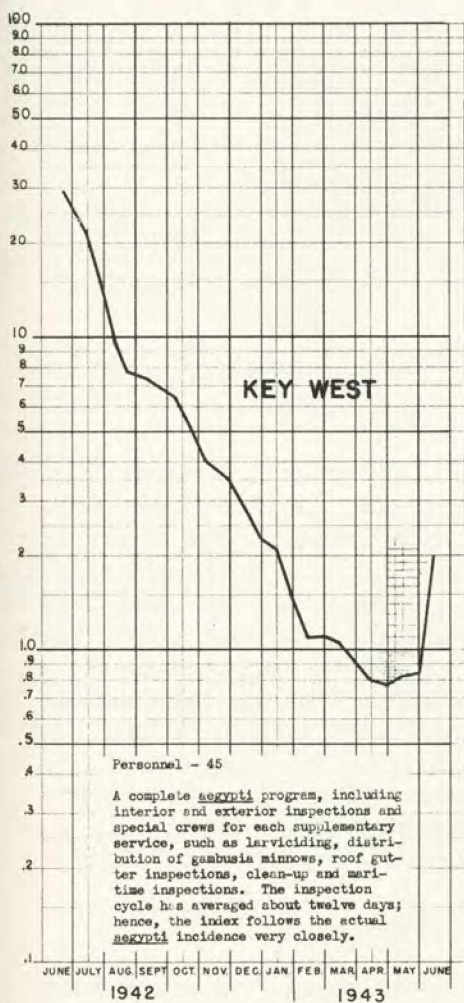
practicability of which has been demonstrated in the principal cities of Brazil. One school believes, however, that the only method of accomplishing elimination is by a concerted, simultaneous attack on every possible type of breeding place in the community from roof gutters to cellar sumps. The other group would first concentrate on the "mother foci", searching out every cistern, shallow well, fire barrel, sump, and similar containers which hold water throughout the entire year. This school would ignore, until the concentrated attack on mother foci has been accomplished, such breeding places as roof gutters which will eventually be flushed out by storms, tin cans which will rust out, flower vases which will be emptied, and other temporary breeding places. They believe that as the mother foci are eliminated "seed" for the non-permanent places will be cut off and incidental breeding in tin cans and flower vases will decrease in direct proportion to the elimination of the mother foci. In fact, continued breeding in vases, cans, and similar containers in an area is considered to be an indication that a mother focus in that immediate area still remains. Observations to date are wholly in accord with this latter procedure as a routine, efficient manner of approach. Under epidemic conditions, where

the quickest possible elimination or reduction of adult females is the ultimate goal and where expense and manpower are of secondary importance, the all-out or "shot-gun" procedure is, of course, the only one to adopt.

When it is considered that the adult female aegypti seldom travels on her own power more than 100 yards from the container in which she lived as a larva, it becomes apparent at once that practically everyone breeds his own household supply. Control is an individual problem, or at most a community problem, which can be solved by individual effort without the need for expensive equipment or large appropriations of public funds. All that is needed is a desire on the part of every individual to do his share in making his community a safer and healthier place in which to live. In the Texas, South Carolina, and Georgia projects, emphasis has accordingly been placed on the educational phases of the program.

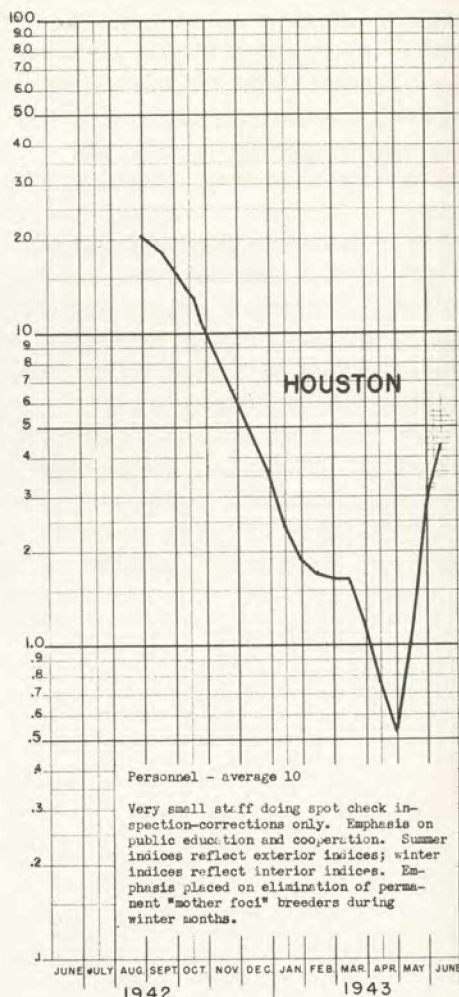
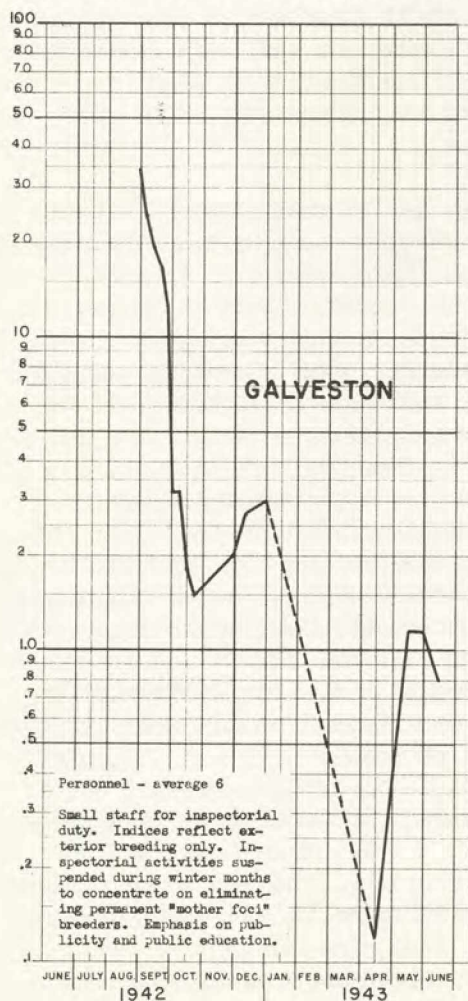
Epidemic-Type Control at Key West

In Florida, the Key West project is being carried on with all the services that would be inaugurated in the event of an epidemic. Inspectors visit each room of every dwelling and business establish-



ment in the city approximately once a week; every potential mother focus in the city is numbered and visited once a week for appropriate treatment; all roof gutters are inspected and cleaned at least once a month; all boats in the harbor are inspected at weekly intervals; vacant lots overgrown with vegetation are cleaned and search is made for breeding containers, hidden wells, and cisterns; tin cans are methodically collected; and the discovery of indoor breeding is followed immediately by aerosol spraying of the premises.

When the Key West project was started in June 1942, the index of breeding was 38 percent of the properties inspected. Looking back on this original survey, the men who made it are confident that if they

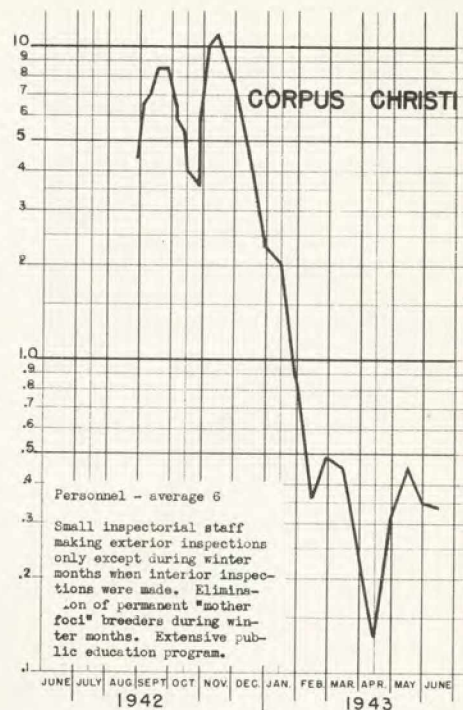
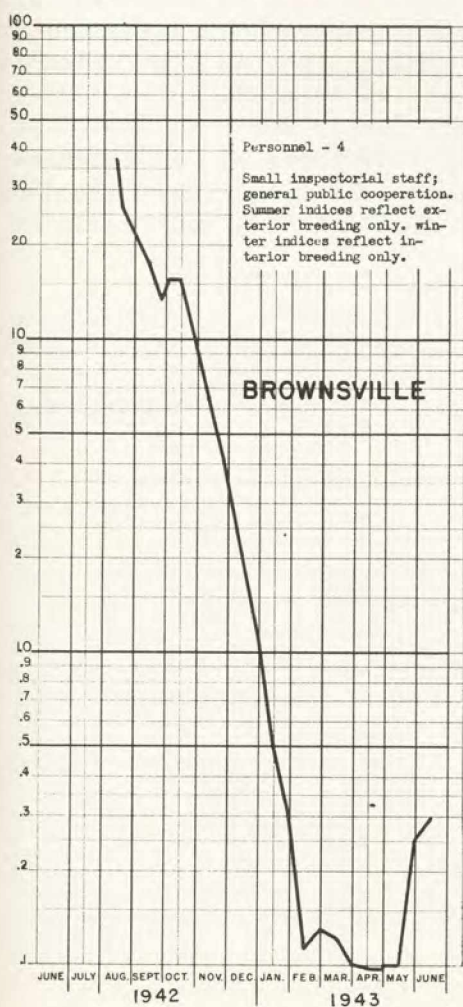


had known the city as well then as they do now the index would have been well over 50 percent. By late summer, when breeding should have been high, the index had fallen to less than 3 percent and by June 1943 it was hovering around 1 percent, with few if any adults escaping to perpetuate the breed. It is hoped that by late summer it can be announced that aegypti mosquitoes have been eliminated from Key West. If such is the case, it will be the first instance of aegypti elimination from a North American city by control methods.

Six Projects in Texas

The results of the educational work supplemented by expert inspection and the incidental correction that accompanies

the inspections, has been surprisingly gratifying. For instance, in Houston, a city of 450,000 people, the paid inspection staff during the 1942 season consisted of only six inspectors. If operations in Houston had been conducted on the same basis as in Key West, with interior and exterior inspection of each premise on a schedule approaching complete coverage of the city each week, and with all the incidental special services of an anti-epidemic campaign, the task would have required 800 employees. By interesting school children, luncheon clubs, firemen, and other organized groups, and by press releases, radio, and movie contacts, the index of premises breeding aegypti was held at a figure con-



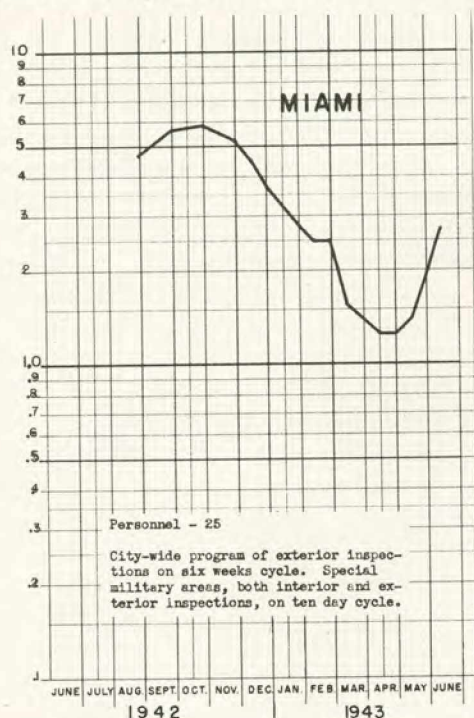
sistently below 5 percent. All of the other projects in Texas -- Galveston, Corpus Christi, Brownsville, San Antonio, and Hidalgo County -- are being conducted on this basis. Major emphasis is on education and public cooperation through individual effort. This is augmented by the efforts of an otherwise entirely inadequate staff of inspectors. During the winter months the personnel on the Texas projects transferred their energies to elimination of permanent mother foci such as cisterns, and eliminated more than a thousand of them by sealing, screening, or filling.

Cooperative Project at Miami

Miami, Miami Beach, and some of the surrounding territory are critical areas from the quarantine standpoint because of the key air fields in the vicinity. Before the war, the Public Health Service supplemented the appropriations of the Dade County Anti-Mosquito District with title VI funds allocated through the State health department to aid in the control of aegypti

mosquitoes. With the inauguration of aegypti control by MCWA, most of the financial responsibility for the aegypti portion of the Miami program was assumed by MCWA in cooperation with the Florida State Board of Health as

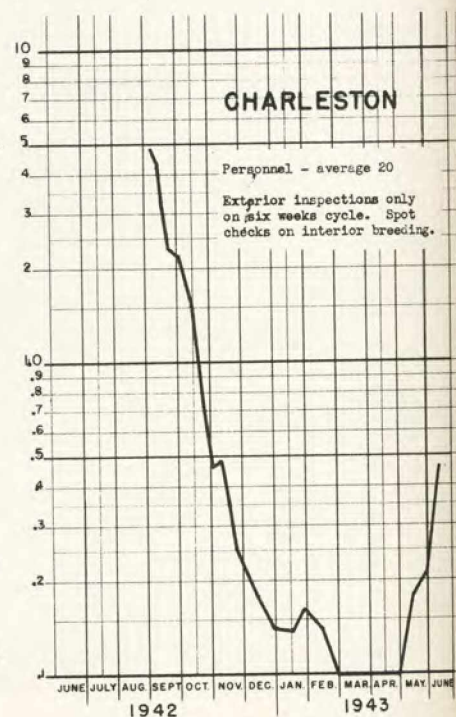
in the case of Key West. The staff was augmented and the director of the Dade County district continued to direct the local work.



ing about 13 percent of premises inspected inside and out, had fallen to barely more than 1 percent.

Charleston Program Augmented

Charleston, too, had been receiving title VI funds through the South Carolina State Board of Health to aid in the control of aegypti mosquitoes. In August 1942 this project was included in the MCWA program and two entomologists were assigned to direct the local inspection staff. For the period August 1 to November 30 the average index for outside inspections only was 2.5 percent. From December 1 to June 30, 1943 the index was consistently below 1 percent, reflecting the fact that Charleston is near the northern limit of the natural range of the species. A little work at Charleston pays surprisingly large dividends. Careful inspection under skilled supervision such as is now being carried on may very well produce elimination at this point even though the inspectional staff of 15 men is probably much too small to cover adequately as large a city as Charleston.



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Mobile Units at Savannah and New Orleans

In March, 1943, a survey and incidental correction program was instituted at Savannah with headquarters at the Henry Rose Carter Memorial Laboratory. Control here is more difficult than in Charleston because of the lack of previous work and the increased biological problem incident to location of the area. Winter breeding apparently is present in Savannah, with approximately twice as much interior as exterior breeding.

At both Charleston and Savannah, an organized educational effort is being developed in the school system to utilize the program of the Victory Corps curricula. The aegypti campaign lends itself particularly well to this program as there is an almost perfect opportunity for education to be translated into constructive action. The effort is being watched with interest as an experiment in the training and utilization of students in intelligent participation in community health programs.

During April a group of 20 inspectors initiated a survey of New Orleans, historic gateway of yellow fever into the United States. During the next fiscal year this project will continue as an inspection-correction program with considerable reliance on public education and cooperating groups. So far, the New Orleans public has shown exceptional interest in the undertaking. A well-devised plan has been developed for utilization of the 10,000 OCD block wardens for inspection and educational activities in case of an actual outbreak of the disease.

Operation of the aegypti program has demonstrated in a number of representative municipalities the possibility of achieving effective control and possibly even of eliminating this species. In every case, except Key West, the work has been kept within a financial range that will permit its continuation by the municipality.

Men and Materials for Epidemic Control

It can easily be seen from the above that the MCWA Aedes aegypti program, which is designed to protect only war projects, cannot assume responsibility for protecting continental United States from the appearance of yellow fever or dengue by eliminating aegypti mosquitoes or reducing them to a point below the "threshold of sanitary importance" at all places where the viruses may possibly be introduced. In fact, the chances are that if either of these diseases does become epidemic it will be at some point where the MCWA program has not been put into effect. As a result of this program there is now a trained force of personnel with full working equipment capable of being marshalled at the request of local or State authorities at any point in the southern States within twenty-four hours after either of these diseases is reported. Working outward in expanding circles from centers of infection, there is no reason why there should be an aegypti mosquito left within seven blocks of the focus at the end of the first day's operations.



The existence of this unit, along with medical precautions such as vaccination, early diagnosis and adequate care of the sick, and an educational campaign to advise the lay public of the necessary precautions, makes it likely that any outbreak of yellow fever or dengue would be brought under control quickly and efficiently.

DOG FLY CONTROL IN WAR AREAS OF FLORIDA

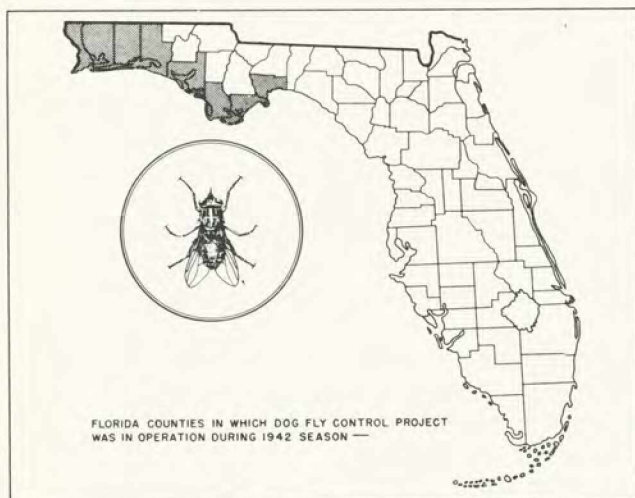


Fig. 27 Extent of Control Area



Fig. 28 Spraying Breeding Grounds

The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture and the Public Health Service, in accordance with a "memorandum of understanding" dated August 3, 1942, cooperated in conducting a dog fly control program for the protection of military activities in northwestern Florida. Funds for the operation of the project were allocated by the United States Army Air Forces. The area covered by control activities is shown in figure 27.

Dog flies (*Stomoxys calcitrans*), known in most parts of the country as "stable flies" breed from August to November in this area in deposits of marine grasses on the shores of bays and sounds. At military bases in this region many of the activities are conducted in the open and in places where great numbers of flies may be concentrated by land breezes. If many flies are present it is impossible to conduct normal outside activities because of severity of the insect's bite.

Control was effected by treating the grass deposits with 25 percent creosote in sea water. The mixture was applied at high pressure from spray machines mounted on small barges and towed near the shoreline (figure 28). Spraying operations began on August 18 and ceased on November 5, 1942, during which period 1,222,950 gallons of spray were applied to 605 miles of grass distributed along a shoreline of 922 miles.

Eight major military establishments and numerous smaller ones such as Civil Air Patrol fields and recreation camps were protected by

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this project. Incidental to the military value of the program was the inestimable benefit to civilian activities throughout the area, many of which are devoted to the war effort.

The total cost of the program, including the purchase of a large part of the equipment, was approximately \$155,000. The success of the project is demonstrated by the low dog fly counts obtained during the course of the control activities. Additional evidence is afforded by statements by officials of various military bases who affirm that the program accomplished its objective and that military activities functioned without interruption throughout the dog fly season.

BLOOD SLIDES FOR THE ARMY

At the outbreak of the war, very few medical schools in this country were well equipped for laboratory study of parasitological diseases. Therefore, under the leadership of several groups, a center was established at the Army Medical School in December 1942 to assemble parasitological materials and redistribute them to all medical schools and other professional training schools in the country. Malaria materials were so scarce that it was feared months would elapse before adequate collections would be made.

In collaboration with the Malaria Investigations Laboratory in Columbia, South Carolina, men and materials were supplied to make enough positive blood smears to relieve the shortage. Approximately 28,000 slides of the three species of malaria plasmodia were furnished to the Army Distributing Center for Parasitological Materials. Most of these slides have been sent to schools where they were urgently needed to train medical men for the armed forces.

TRAINING AND EDUCATION

With the tremendous turn over in personnel (60% during the fiscal year), it became increasingly obvious that one of the bottle-necks of the MCWA program would be trained personnel. The only solution was the development of a sound in-service training program, utilizing the facilities of MCWA for training new personnel and for continuing the training of certain persons already employed. Plans were developed under the guidance of the Medical, Engineering, and Entomological Sections. This training program is administered by the Executive Office in order that it may combine all three professional points of view and thus serve all sections equally.

The training course which was developed presents basic malaria problems and MCWA methods of control by means of a one-week classroom course equally suitable for any of the professional or sub-professional trainees. Field training to supplement the basic course is provided in accordance with specific needs which are determined by an analysis of the work the individual will perform and the type of knowledge and skill that is necessary.

With the decrease in experienced manpower available for teaching and with a marked increase in the number of trainees, the need for devising efficient training techniques became more and more apparent. The obvious answer was the use of more visual and auditory materials since these are recognized as better substitutes for personal teaching than the printed page. An attempt to collect sufficient materials of this type revealed an extreme shortage and made it necessary to develop means of producing such essential training aides. This was done through the various production units of the Division of Sanitary Reports and Statistics. Similar materials were also produced for the Community Education Program.

Care has been taken to utilize all available materials and to avoid duplication. To this end, meetings were held with other agencies interested in the production of visual materials concerning malaria. These agencies agreed to keep one another informed about their activities.

The well-equipped photographic laboratory in the Malaria Investigations Laboratory in Columbia, South Carolina, was, with little added expense, turned into a photographic production unit. The Tennessee Valley Authority had several thousand feet of unedited film which contained much basically valuable technical material. Through a cooperative agreement facilities were set up for editing some of this film into concise units which could be used for instructing the MCWA technical staff. Similar types of cooperative enterprises with other organizations are contemplated.

Scripts were written for several motion picture films and film strips. Field shooting of two films has been completed and a third is in progress. The Graphics Section of the Division of Sanitary Reports and Statistics, cooperating with MCWA, is preparing a series of drawings to be used in a film strip. The production schedule calls for making sound and silent films in black-and-white and technicolor. A library of slides, film strips, and photographs for in-service training and lay education is being assembled.

COMMUNITY EDUCATION FOR MALARIA CONTROL

Complete protection of either troops or war workers is impossible if they spend much time in uncontrolled malarious areas. Evening walks in areas five to ten miles from cities and camps are common. {War workers and military personnel sometimes live alone or in small groups away from protected zones.} The need for reducing or keeping low the endemic malaria reservoir in these wider areas led to the development of the Community Education Program. The effects of such a program -- the action of residents of the broader zones in fighting malaria -- is a safeguard against rising rates which will influence the immediate control zone. In a lesser degree it is similar in effect to the main job.

An experimental program in 1942 was planned in collaboration with the Division of Sanitary Reports and Statistics and several State

health officers. The experimental program was limited to twenty-six counties in seven States.

Assistants in health education, principally school teachers, were recruited on recommendations of local health officers. The twenty-six persons employed received a ten-day intensive training course in malaria and in the techniques of community education, effective methods of leading people to face, study, and solve their own problems. They returned to their respective communities to carry on malaria education as regular members of the local health department. Since the effective-

RESULTS OF COMMUNITY EDUCATION PROGRAM - 1942

PEOPLE LEARNED ABOUT MALARIA

THEY DID SOMETHING ABOUT IT


 MEETINGS
ATTENDANCE 38,648


1,050

 HOUSES SCREENED 468

 PERSONAL CONTACTS

10,487

 HOUSES - SCREENS REPAIRED 1,529


 DISPLAYS AND EXHIBITS

83


 PONDS OR DITCHES CLEANED 139

 NEWS ARTICLES

362

 RADIO PROGRAMS

63

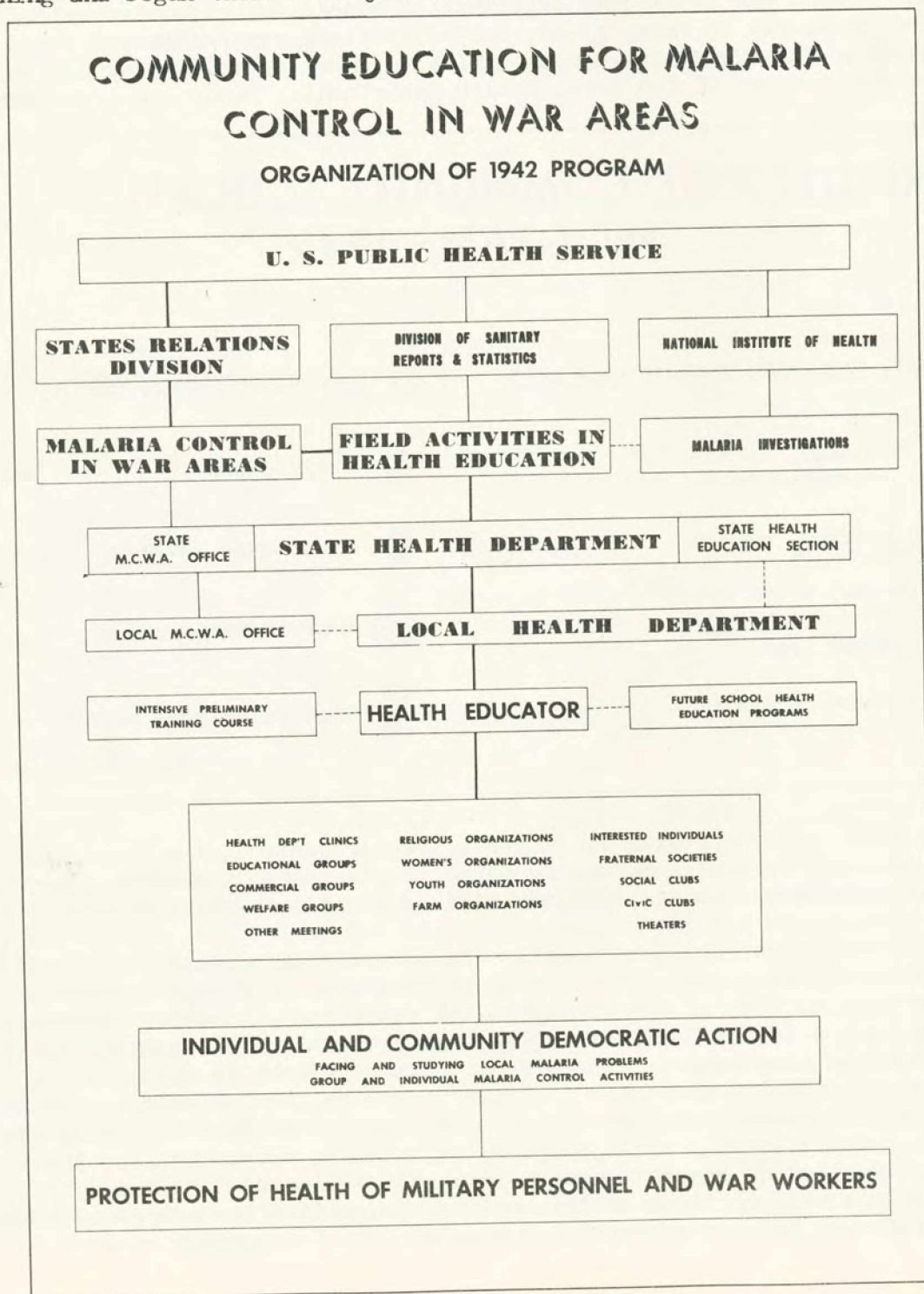
 PLACES SPRAYED, DUSTED, OR OILED 796

of the MCWA control program is judged by vector control, the community education must be judged by how much the people themselves do to control mosquitoes. These results are indicated on the accompanying chart.

The contributions made by the educational program reach beyond the immediate observable effects. Among them are: A firmer entrenchment of the position of the County health department, a better cooperation of schools and health departments, and carry-over into the schools by the teachers when they return. The effect of this program on establishing comprehensive health education programs in several health departments and many school systems; the demonstration of what can be done in health education in counties with small budgets; stimulating people to face their own problems and do something about them; the increased likelihood that local groups will continue malaria control programs after emergency funds are withdrawn; and the successful demonstration of democracy at work in

the realm of communities facing their health problems--are all contributions which in broad perspective may be as important as the direct contribution to malaria control efforts.

Since State and County health officials were generally enthusiastic about the results, this year 92 educators were employed in as many counties in 13 States. Following the 1942 plan they were given their training and began their work just as the fiscal year closed.



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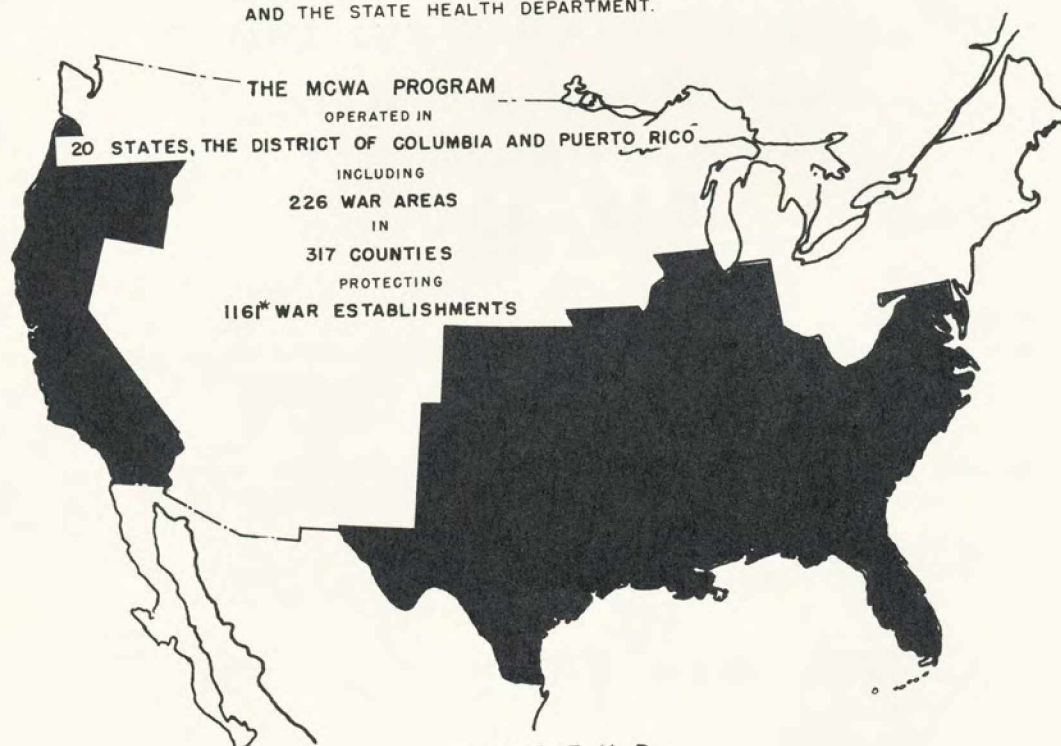
MALARIA CONTROL IN WAR AREAS

1942 - 43

PART III

State Section

MCWA OPERATES IN EACH STATE AS A COOPERATIVE
ENTERPRISE BETWEEN THE PUBLIC HEALTH SERVICE
AND THE STATE HEALTH DEPARTMENT.



L E G E N D



* WAR ESTABLISHMENTS PROTECTED AS OF JUNE 30, 1943
(INCLUDING 17 IN KANSAS AND 1 IN OREGON)

NOTE SYMBOLS ON STATE MAPS IN THIS SECTION ARE ARRANGED ON A COUNTY BASIS

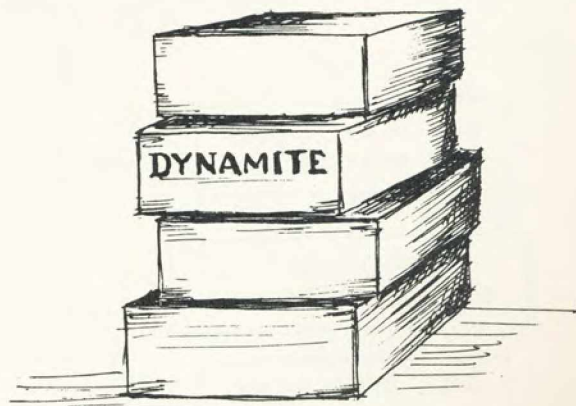


STATE OF ALABAMA
DEPARTMENT OF PUBLIC HEALTH
MONTGOMERY

B. F. AUSTIN, M. D.
STATE HEALTH OFFICER



In the vicinity of war establishments in the State of Alabama approximately 24 miles of hand ditching were completed by MCWA during the past year. This, with about two miles of dynamited ditch, resulted in the permanent elimination of many mosquito breeding areas. Completion of major drainage work in one War Area eliminated need for further control there and in other areas reduced necessary control operations very radically. A total of 472 acres of water surface was treated with an average of 23 gallons of oil per acre, and small scale vegetation clearing operations were carried out. In all 188,105 man-hours of labor were expended for both major drainage and larviciding.



B. F. Austin

B. F. Austin, M. D.
State Health Officer.

ARKANSAS STATE BOARD OF HEALTH



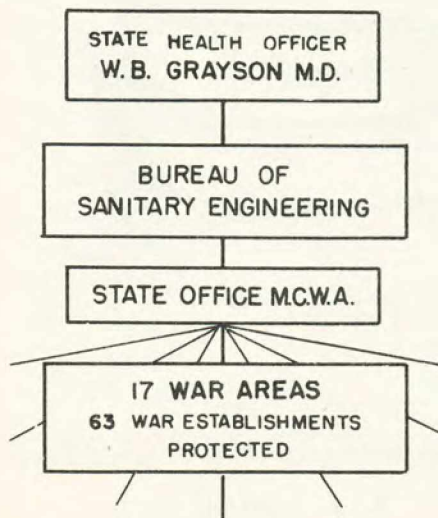
W.B. GRAYSON, M.D.
STATE HEALTH OFFICER

BOARD MEMBERS
E.D. McKNIGHT, M.D.
J.G. GLADDEN, M.D.
M.E. McCASKILL, M.D.
F.O. MAHONY, M.D.
W.G. HODGES, M.D.
THOS. WILSON, M.D.
L.D. DUNCAN, M.D.

LITTLE ROCK



Achievements by MCWA in Arkansas during the past year included the economical construction of 12 miles of dynamited ditch. In one War Area a small crew using dynamite removed 20,000 cubic yards of excavation and constructed 6,000 lineal feet of ditch at a total cost of \$8,000. The use of a dragline, if such had been possible in the swamp, would have cost about \$20,000. One major drainage project involving the use of a dragline was completed and 46 miles of ditch were excavated by hand. Water surfaces totaling 9,650 acres in the vicinity of war establishments were treated with paris green and oil. The clearing of over 1,000 acres was accomplished to facilitate larviciding. Recently airplane dusting with paris green of large rice field areas near Walnut Ridge and Newport was started. The MCWA work was accomplished with the expenditure of only 324,045 man-hours of labor.



W.B. Grayson

W. B. Grayson, M. D.
State Health Officer



STATE OF CALIFORNIA
Department of Public Health



In the State of California the campaign against Anopheles freeborni, the vector of malaria in that state, involved the treatment with oil of 2,511 acres of water surface and the construction by hand of over 9 miles of ditch. A total of 147 acres of water surface was eliminated and a nearly equal extent cleared of vegetation.

Air fields at Porterville, Visalia and Merced and a congregating center at Marysville for troops from Camp Beale were included in the program. Inspection at Hammond General hospital at Modesta returned data that indicated the necessity for control next year.



DIRECTOR OF PUBLIC HEALTH
WILTON L. HALVERSON M.D.

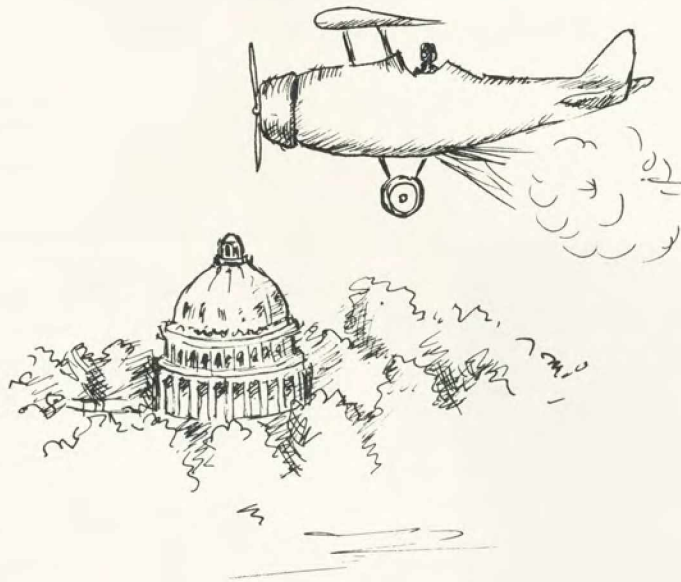
BUREAU OF
SANITARY ENGINEERING

STATE OFFICE MC.W.A.

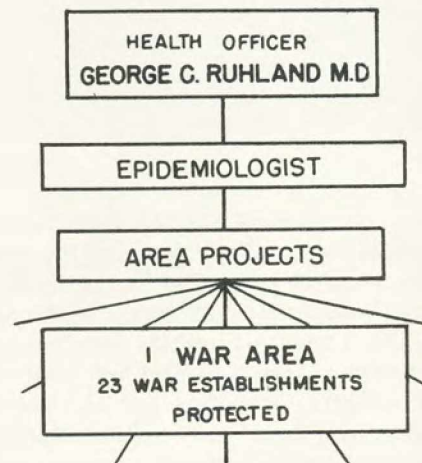
4 WAR AREAS
11 WAR ESTABLISHMENTS
PROTECTED

Wilton L. Halverson
Director of Public Health

GOVERNMENT OF THE DISTRICT OF COLUMBIA
OFFICE OF THE HEALTH DEPARTMENT



The District of Columbia shares with Virginia and Maryland the problem of controlling mosquitoes in the water chestnut growth in the Potomac River. Last year 3,500 acres of water chestnut were dusted with paris green by airplane and the same means of control will continue to be utilized, since it is the only practicable method of effecting control. The work was performed at a very low unit cost per acre. Other control work around the Capital of the Nation included about 22 miles of hand ditching and the oiling or clearing of small water surface acreages. The above work was performed with 41,883 man hours of labor.



George C. Ruhland

George C. Ruhland, M. D.
Health Officer

WILLIAM PARR, PH. G., MEMBER

TAMPA

HERBERT L. BRYANS, M. D., PRESIDENT

PENSACOLA

ROBERT B. MCIVER, M. D., MEMBER

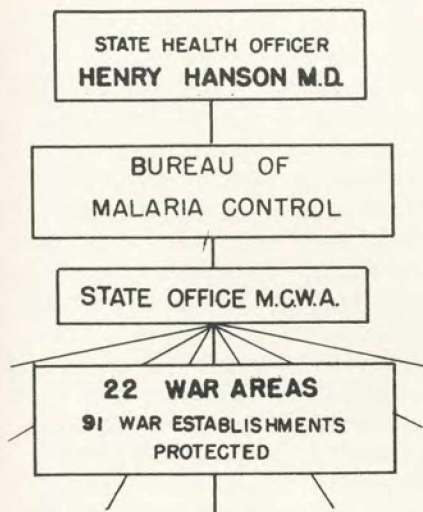
JACKSONVILLE



Florida State Board of Health

HENRY HANSON, M. D., STATE HEALTH OFFICER

POST OFFICE
BOX 210



In the State of Florida over 182 miles of hand ditching was accomplished in the past year—the greatest amount done in any State on the MCWA program. Florida also led the states in the extent of breeding water surface permanently eliminated, which has already effected a significant reduction in man power required to continue control in these areas. Dynamite was used in the construction of about 9 miles of ditch, and 9,365 acres of water surface were treated with mosquito larvicides. At Key West the campaign against the Yellow Fever mosquito reduced the Aedes aegypti index from 29 percent to only one percent. At Miami, Aedes aegypti control was concentrated around military zones.

JACKSONVILLE



Henry Hanson

Henry Hanson, M. D.,
State Health Officer.

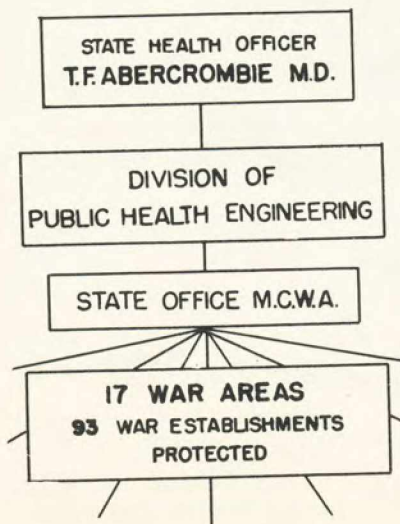


STATE OF GEORGIA
DEPARTMENT OF PUBLIC HEALTH

T. F. ABERCROMBIE, M. D., DIRECTOR
ATLANTA



In Georgia A. quadrimaculatus was controlled primarily through the use of paris green as a larvicide. A highly perfected and integrated system of entomological and operational reports is in use in this state. In all, during the past year over 15,120 acres of water surface were dusted. In addition over 42 miles of ditching was accomplished by hand, and over 352 acres were cleared of aquatic vegetation. Altogether 257,391 man-hours were expended in work around war establishments. In Savannah, headquarters for the Aedes aegypti control unit were set up in the Henry Rose Carter Memorial Laboratory, named for the Public Health Service pioneer in the study of Yellow Fever.



T. F. Abercrombie

T. F. Abercrombie, M.D.
Director

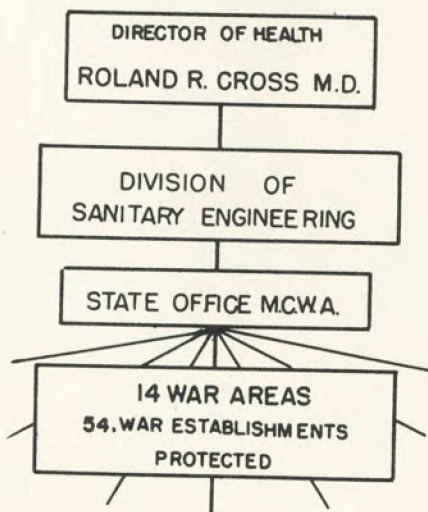
STATE OF ILLINOIS
 DWIGHT H. GREEN, GOVERNOR
 DEPARTMENT OF PUBLIC HEALTH
 SPRINGFIELD

ROLAND R. CROSS, M. D.
 DIRECTOR

H. L. PETTITT, M. D.
 ASSISTANT DIRECTOR

ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR

Illinois lies on the border of the malarious section, but the A. quadrimaculatus population was high and the malaria hazard in certain war areas was deemed sufficiently great to justify control work. Last year over 3 miles of hand ditching was accomplished and approximately 600 acres of water surface was treated with oil or paris green. In one area in close proximity to an Army air field on which pilots were being trained, a small amount of excavation (only about 70 cubic yards) resulted in the elimination of the greater part of a prolific quad breeding place. In addition about 84 acres were cleared of aquatic vegetation. The above operation entailed the expenditure of 36,821 man-hours of labor.

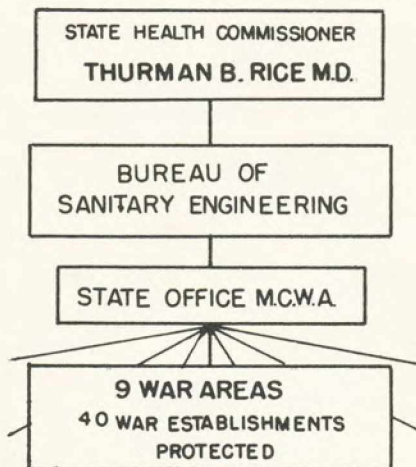


Roland R. Cross
 Roland R. Cross, M.D.
 Director

STATE OF INDIANA



STATE BOARD OF HEALTH



Indiana is one of the states lying on the border of the malarious portion of the United States, and the MCWA program in that state consisted mostly of inspection to detect any outbreak of malaria or malaria mosquitoes. In the single operational area in the state, however, over a mile of hand ditching was accomplished, and breeding surfaces totaling 101 acres were treated with larvicides. A total of 21,920 man hours of labor were expended.



Thurman B. Rice

Thurman B. Rice M.D.
State Health Officer

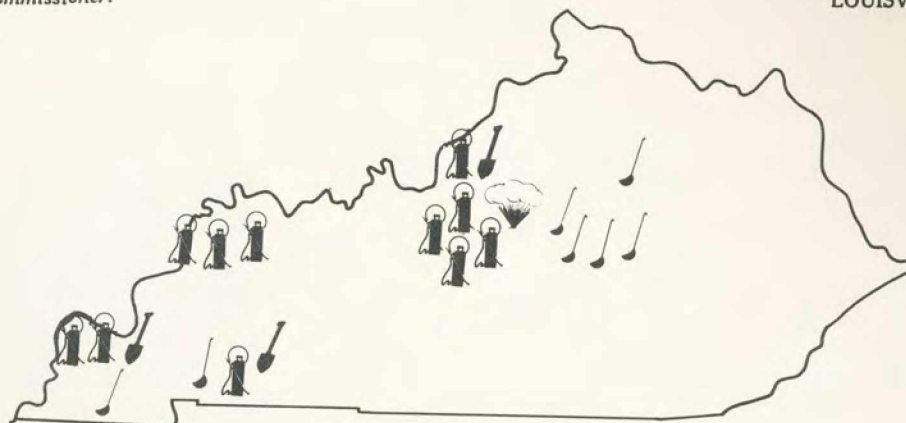
"THE HEALTH OF THE PEOPLE IS REALLY THE FOUNDATION UPON WHICH ALL THEIR HAPPINESS AND ALL THEIR POWERS AS A STATE DEPEND. —DISRAELI."

We Want a League, Offensive and Defensive, With Every Well-Wisher of Kentucky and Her People.

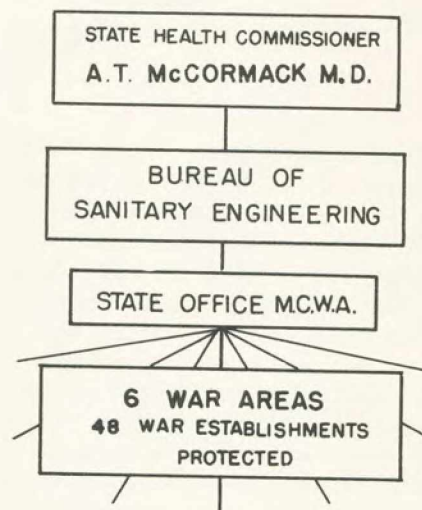
State Department of Health of Kentucky

A. T. McCORMACK, M. D.,
State Health Commissioner.

620 South Third Street,
LOUISVILLE, KENTUCKY.



In the campaign against Anopheles quadrimaculatus in Kentucky during the year just past, MCWA larvicided about 2,000 acres of water surface, 23,138 gallons of oil being used. In addition about 10 miles of hand ditching was accomplished, and 2,550 pounds dynamite was used in the excavation of 1,800 linear feet of ditch. A total of 135,353 man-hours of labor was required to conduct the MCWA operations around war establishments in Kentucky last year.



A. T. McCormack
A. T. McCormack
State Health Commissioner

State of Louisiana

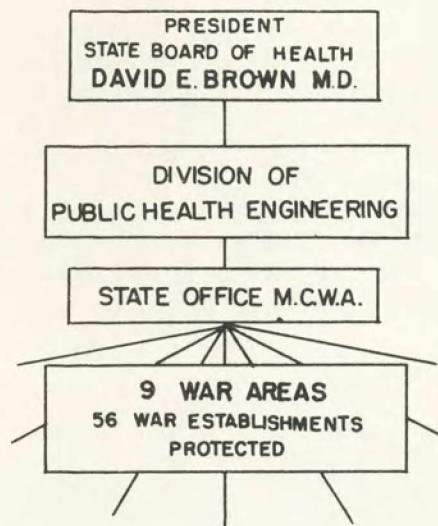


DEPARTMENT OF HEALTH
CIVIL COURTS BUILDING
New Orleans

DAVID E. BROWN, M. D.
STATE HEALTH OFFICER



During fiscal year 1943, MCWA treated a total of 61,846 acres of breeding water in Louisiana with oil. This constituted the greatest acreage larvicided by any state included in the program and more than three-quarters of a million gallons of oil were used for this purpose. In addition large breeding places were eliminated by almost 105 miles of ditching and a considerable amount of vegetation and debris was removed. Recently an airplane dusting project was initiated at New Orleans and two more will be begun in the near future. 2,000 acres of breeding surface in close proximity to war establishments will be treated with paris green in this manner. During the year an Aedes aegypti unit started control in New Orleans, the historic gateway of Yellow Fever.



David E. Brown M.D.

State Health Officer



State of Maryland
Department of Health

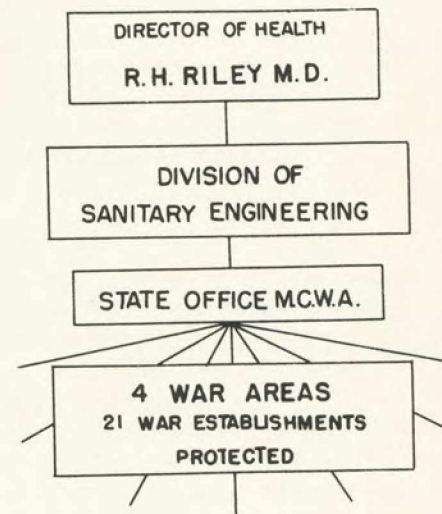
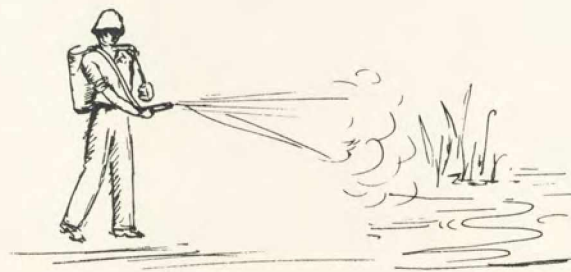
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2411 N. CHARLES ST., BALTIMORE

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Maryland shares with Virginia and the District of Columbia the water chestnut problem. This aquatic weed in the Potomac River forms an excellent breeding place for malaria mosquitoes. It is known scientifically as Trapa natans and was introduced to this country from the Far East. Airplane dusting has been employed in control and 3,500 acres were treated with paris green during the past year in the two States and the District. In addition almost 8 miles of hand ditching was completed in Maryland, which served to eliminate a considerable breeding area. About 21 acres were cleared of aquatic vegetation. A total of 36,544 man-hours was expended.

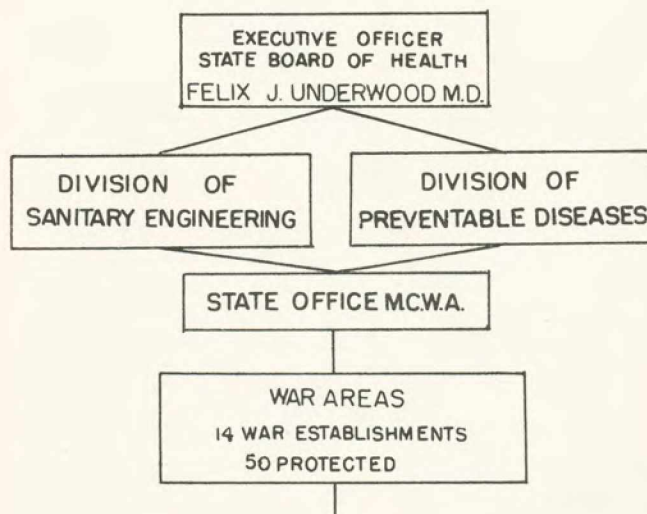


R. H. Riley
R. H. Riley, M. D.,
Director.

MISSISSIPPI STATE BOARD OF HEALTH

FELIX J. UNDERWOOD, M. D., EXECUTIVE OFFICER

JACKSON, MISSISSIPPI



In the State of Mississippi about 46 miles of hand ditching was completed during the year. Durable linings were installed in about 1,514 linear feet of ditch, and large acreages of water surface were eliminated, thereby reducing the future larvicidal load in these areas. Oiling was used for the control of 1,202 acres and 723 acres were cleared of vegetation. In these MCWA operations the total man hours expended was 267,723. Airplane dusting with paris green was recently initiated at Greenville. By cooperative agreement with Arkansas, breeding places on Archer Island, lying within the Arkansas boundary in the Mississippi River near Greenville, are being controlled by this method under the supervision of the Mississippi authorities.



Felix J. Underwood

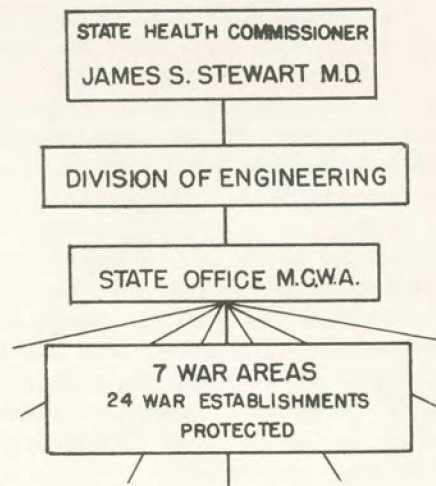
Felix J. Underwood MD
Executive Officer
State Board Of Health



ADDRESS ALL COMMUNICATIONS
TO THE STATE BOARD OF HEALTH

JAMES STEWART, M. D.
STATE HEALTH COMMISSIONER

THE STATE BOARD OF HEALTH
OF MISSOURI
JEFFERSON CITY



Mosquito control operations around war establishments in Missouri during the past year involved both drainage and larviciding. Vertical drainage near Jefferson Barracks eliminated six acres of breeding surface. In all, nearly 3 miles of hand ditching was finished and over 1,164 acres of water surface treated with oil and paris green. Clearing operations were carried out over 180 acres of water surface and a small amount of dynamite was used. A total of 58,052 man-hours of work were expended for this purpose.



James Stewart M. D.
James Stewart, M. D.
State Health Commissioner

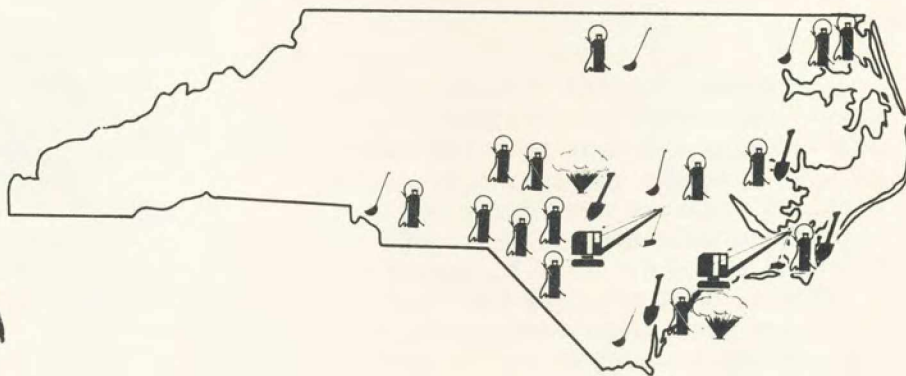
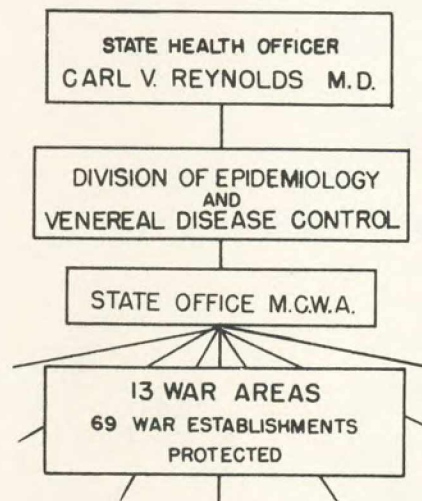


NORTH CAROLINA
STATE BOARD OF HEALTH

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SECRETARY-TREASURER
AND
STATE HEALTH OFFICER
GEO. M. COOPER, M. D.
ASST. STATE HEALTH OFFICER

RALEIGH

In North Carolina during the year draglines were used in three areas to excavate a total of about 5 miles of large ditch. This accomplishment gave North Carolina the lead among MCWA units in amount of machine ditching. In addition to the above, over 129 miles were ditched by hand, and a small amount of dynamite ditching was completed. Oil was used to control quads in water areas with an extent totaling 5,647 acres, and vegetation was cleared from 979 acres of water surface. In all 587,737 man-hours of labor were expended.



Carl V. Reynolds

Carl V. Reynolds, M. D.
Secretary and State Health Officer

G. F. MATHEWS, M. D.
COMMISSIONER

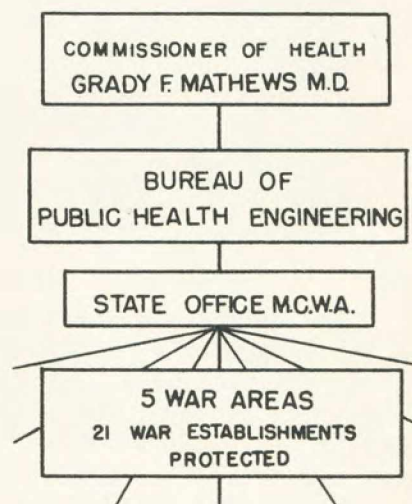
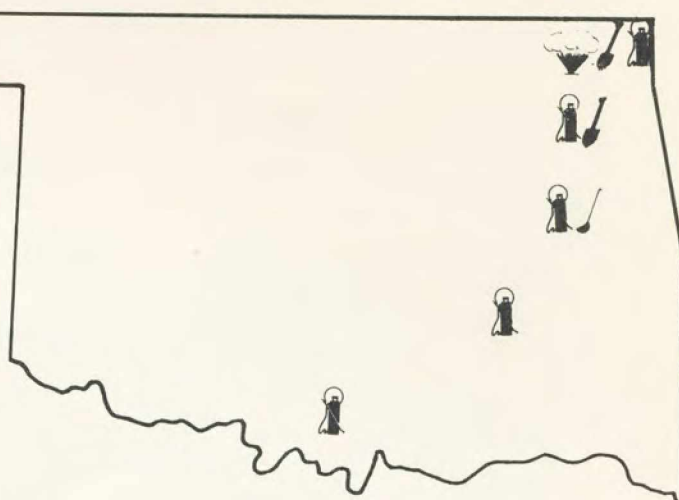


EDUCATION. IMMUNIZATION.
SANITATION IS HEALTH
CONSERVATION

Oklahoma State Health Department

State of Oklahoma
OKLAHOMA CITY

Malaria control drainage in Oklahoma during the past year resulted in the elimination of many sources of malaria mosquitoes. Over 23 miles of ditch were completed, 19 miles by hand and 4 miles by dynamiting. In one War Area a ditch 4,650 lineal feet long, 3 feet deep, 6 feet wide at the top and 2 feet wide at the bottom was constructed with dynamite in only two days. 2,250 feet were completed the first day, and the remaining 2,400 feet the second day. An average of 1.33 cubic yards of earth were moved for every pound of dynamite used. A total of 9,200 pounds of explosive was used. Removal of storm deposited logs and other drift from natural bayous and drainage ditches near Pryor resulted in the elimination of prolific sources of quads. Waters breeding quads with an extent of 1,039 acres were treated with oil and paris green, and 287 acres were cleared of aquatic vegetation.



G. F. Mathews
The State Health Commissioner

PUERTO RICO

9 WAR AREAS
22 WAR ESTABLISHMENTS
PROTECTED



The campaign against malaria on the island of Puerto Rico required the control of Anopheles albimanus, probably the most important Caribbean vector of malaria. In the fight against this species several outstanding major drainage projects were completed among them being that at Camp Tortuguero. Electric pumps to dewater some extensive albimanus breeding grounds were installed in the Losey Field area in co-operation with the Army. Alto-

gether in Puerto Rico MCWA completed nearly 178 miles of hand ditching during the past year. Waters totaling over 39,353 acres in extent were treated almost exclusively with paris green, this larvicide being more extensively used by Puerto Rico than by any of the other MCWA units. Airplanes were used for the application of paris green in some instances. In all 891,491 hours of work were expended.

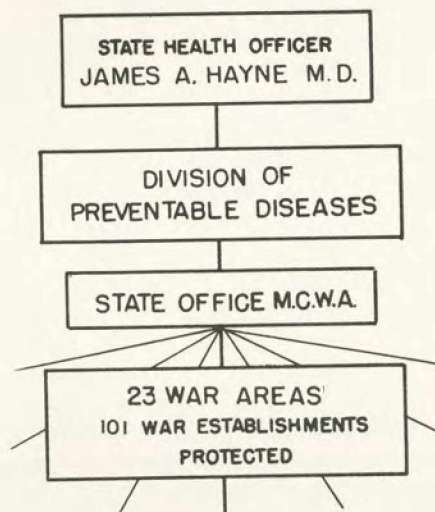
DEPARTMENT OF HEALTH
JAMES A. HAYNE, M.D., D.P.H.
SECRETARY AND STATE HEALTH OFFICER
WADE HAMPTON STATE OFFICE BLDG.
PHONE 2-6321



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State Board of Health of South Carolina

Columbia, S. C.



Malaria control around war establishments in South Carolina involved the treatment of about 12,298 acres of water, both oil and paris green being used as larvicides. The MCWA program completed more than 100 miles of hand excavated ditch and blasted an additional 5 miles with dynamite. In one case the drainage of a large prolific quad, breeding area in close proximity to an air field which would have required 18 months to drain with a dragline was finished in about 60 days through the use of dynamite. Durable lining was installed in more than a mile of ditch, the most of any state in the MCWA program, and 6,100 linear feet were ditched with machinery. Over 429 acres of water surface was eliminated by major and minor drainage and vegetation was cleared from 2,636 acres. An Aedes aegypti control program was initiated in Charleston and no exterior breeding was found in March or April.

James A Hayne
JAMES A. HAYNE, M.D., DR.P.H.
SECRETARY AND STATE HEALTH OFFICER

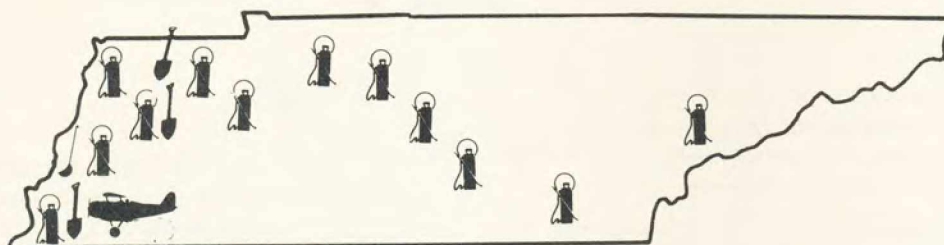


W. C. WILLIAMS, M.D.
COMMISSIONER OF PUBLIC HEALTH

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
NASHVILLE

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During the year the MCWA program in Tennessee controlled A. quadrimaculatus production by oiling waters totaling 3,310 acres in extent. A considerable acreage of water was eliminated by 27 miles of hand ditching, and 387 acres were cleared of vegetation. 1,275 feet of durable ditch lining was placed. The above efforts involved 168,328 man-hours of work by MCWA personnel. A project for the control of breeding in flooded areas near war establishments north of Memphis by means of airplane dusting of paris green was recently initiated.

COMMISSIONER OF PUBLIC HEALTH
W. C. WILLIAMS M.D.

DIVISION OF
PREVENTABLE DISEASES

STATE OFFICE MCW.A.

10 WAR AREAS
69 WAR ESTABLISHMENTS
PROTECTED

W. C. Williams

Commissioner

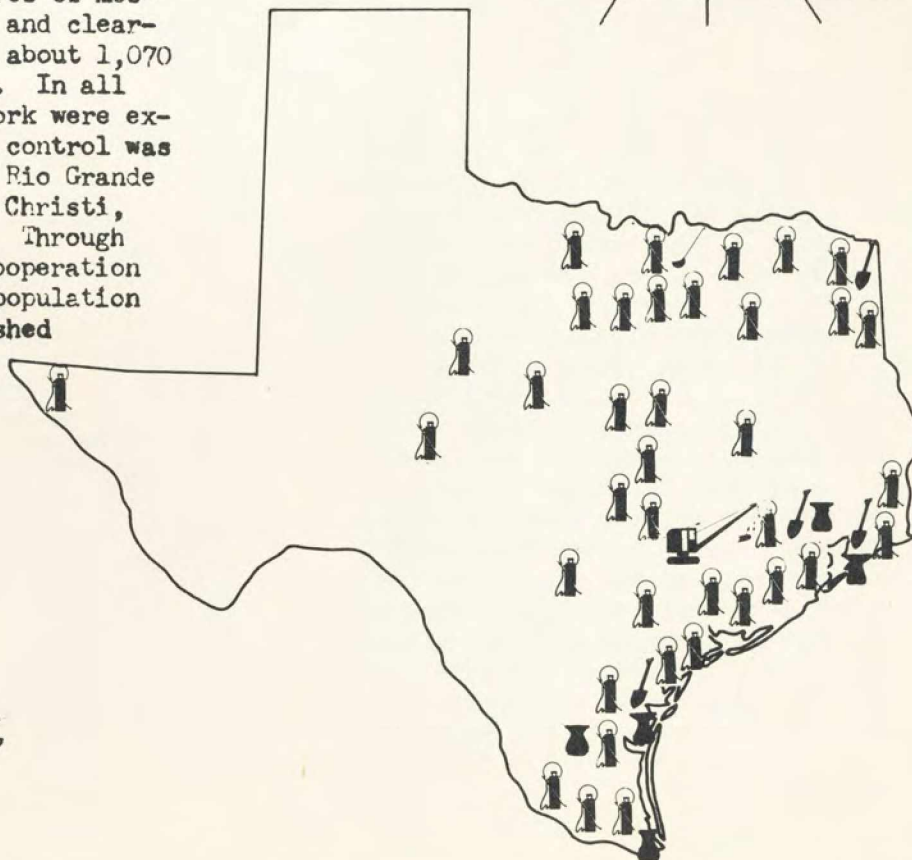
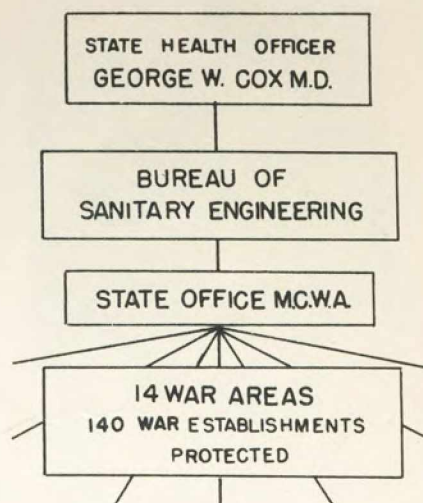


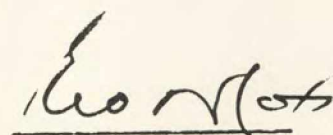
TEXAS STATE BOARD OF HEALTH

GEO W COX, M.D. STATE HEALTH OFFICER

AUSTIN

Texas is unique among the states included in the MCWA program in that it is necessary to control two dangerous malaria vectors. In addition to Anopheles quadrimaculatus, a second species, Anopheles albimanus, is found in numbers in the lower Rio Grande valley. During the past year in Texas, 13,143 acres of water surface were treated with larvicides. Over 325,000 gallons of oil and 1,500 pounds of paris green were used. hand ditching of 156 miles was completed permanently eliminating well over 1,200 acres of mosquito breeding waters, and clearing of vegetation from about 1,070 acres was accomplished. In all 641,127 man-hours of work were expended. Aedes aegypti control was initiated in the lower Rio Grande valley and near Corpus Christi, Houston and Galveston. Through public education and cooperation notable Aedes aegypti population reduction was accomplished

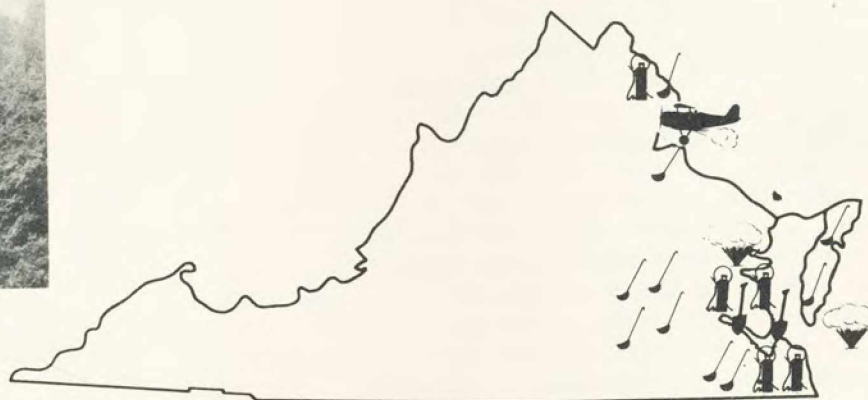



Geo. W. Cox, M. D.
State Health Officer

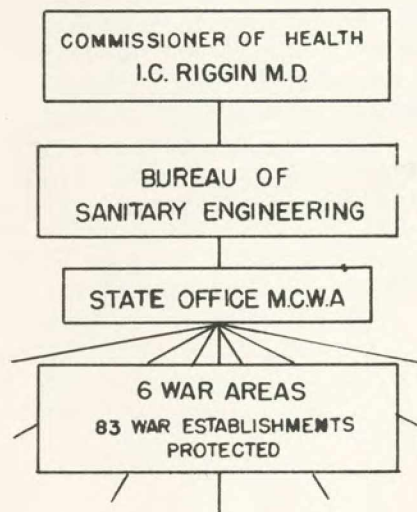


I. C. RIGGIN, M. D.
COMMISSIONER

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF HEALTH
RICHMOND



Virginia, with Maryland and the District of Columbia, is concerned with the prevention of quad breeding in growths of water chestnut in the vicinity of war establishments along the Potomac River. During the past year it was necessary to control 3,500 acres by airplane application of paris green. Other work by MCWA in Virginia was concentrated in the Norfolk-Portsmouth, Virginia Beach and Peninsula areas and included 107 miles of hand ditching. A notable achievement was the dynamite drainage of a series of heavily breeding marshy areas at Dam Neck. The use of dynamite resulted in a saving of \$72,000 as compared with the estimated cost for use of a dredge. More than 21,280 acres of water surface were treated with oil and paris green and over 976 acres were cleared of vegetation.



I. C. Rigg
State Health Commissioner

BREAK THE MALARIA CHAIN

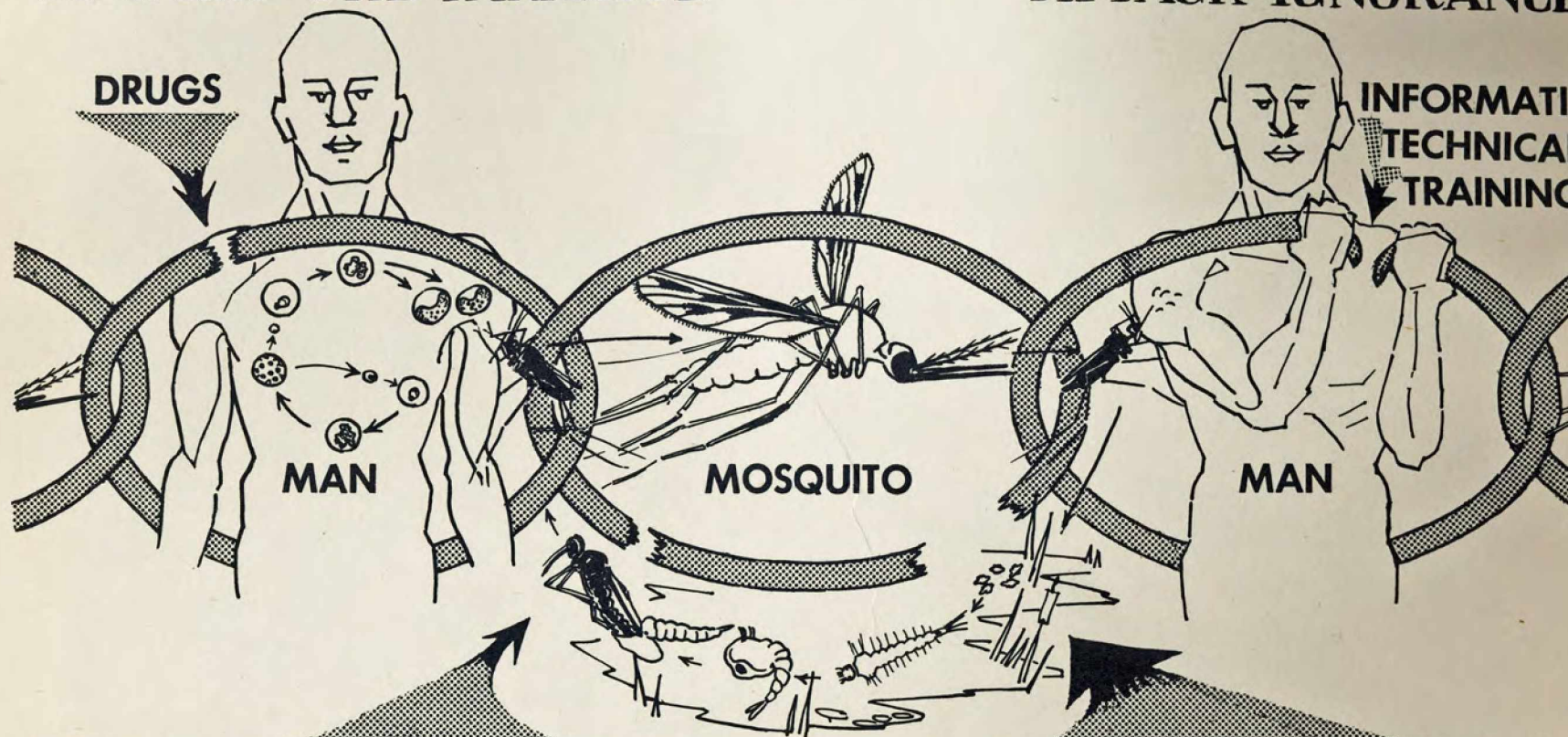
ATTACK

ATTACK

ATTACK

ATTACK THE PARASITE

ATTACK IGNORANCE



ATTACK ADULT MOSQUITOES

ATTACK MOSQUITO LARVA

MOSQUITO - PROOFING

OILING

SPRAYING

DUSTING

REPELLENTS

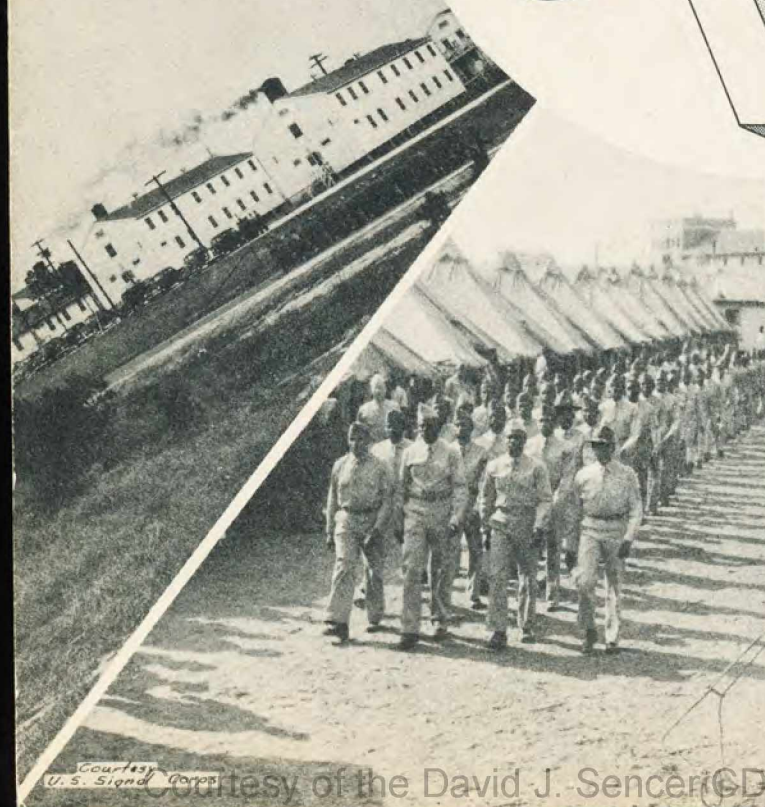
DRAINING

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